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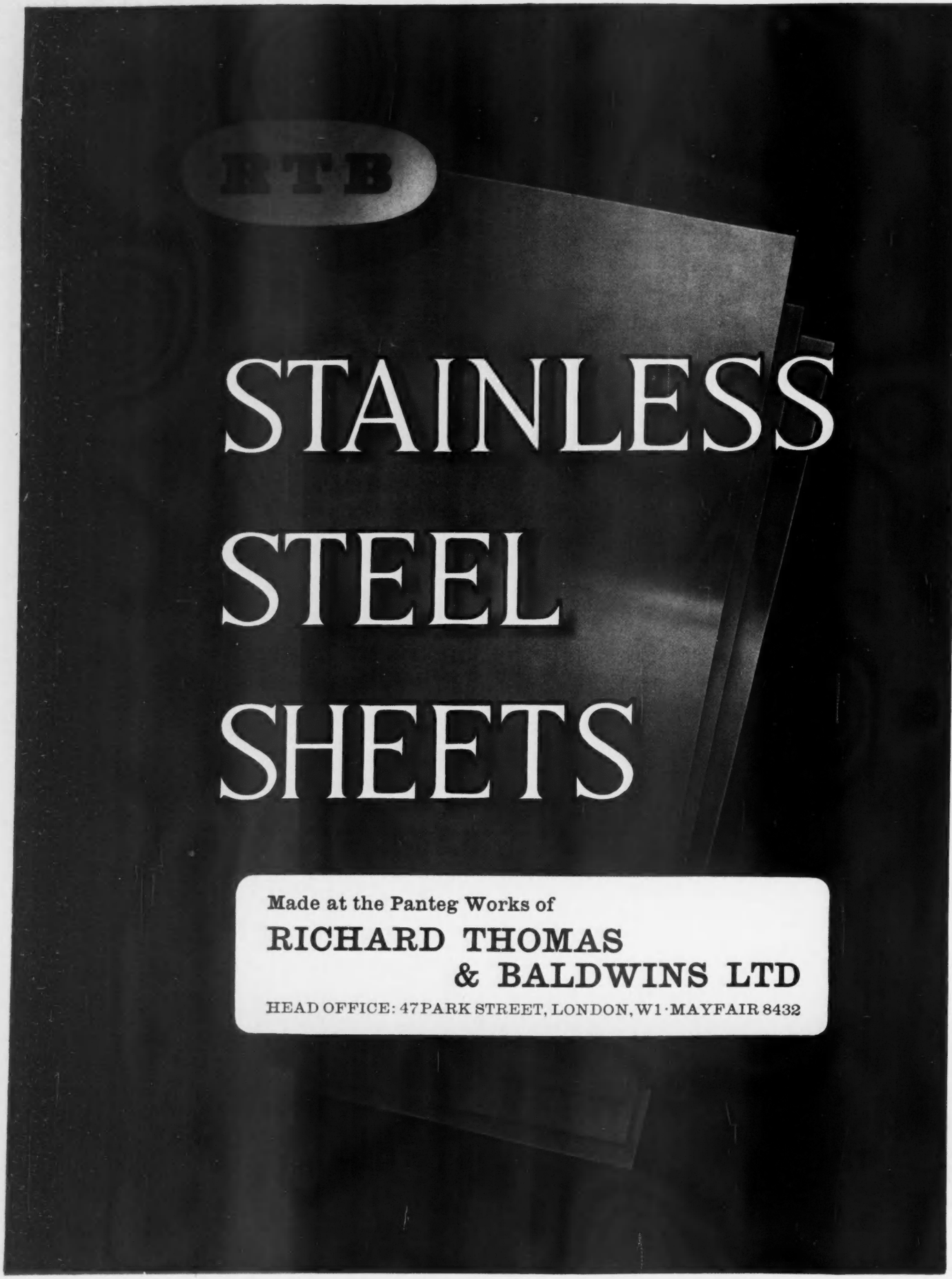
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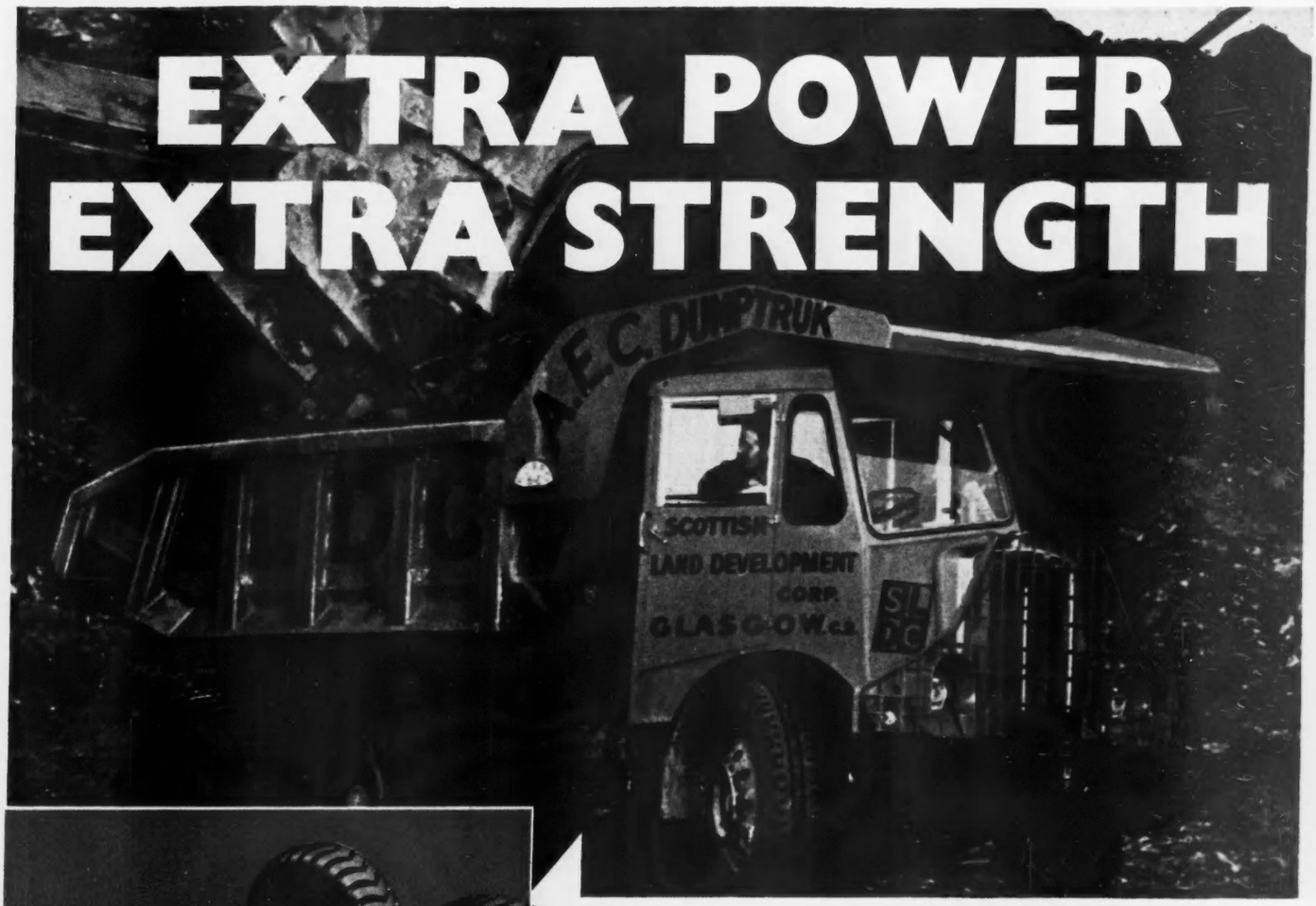

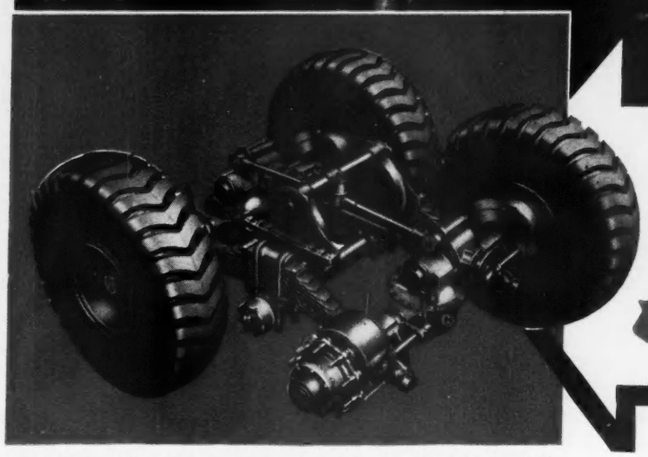

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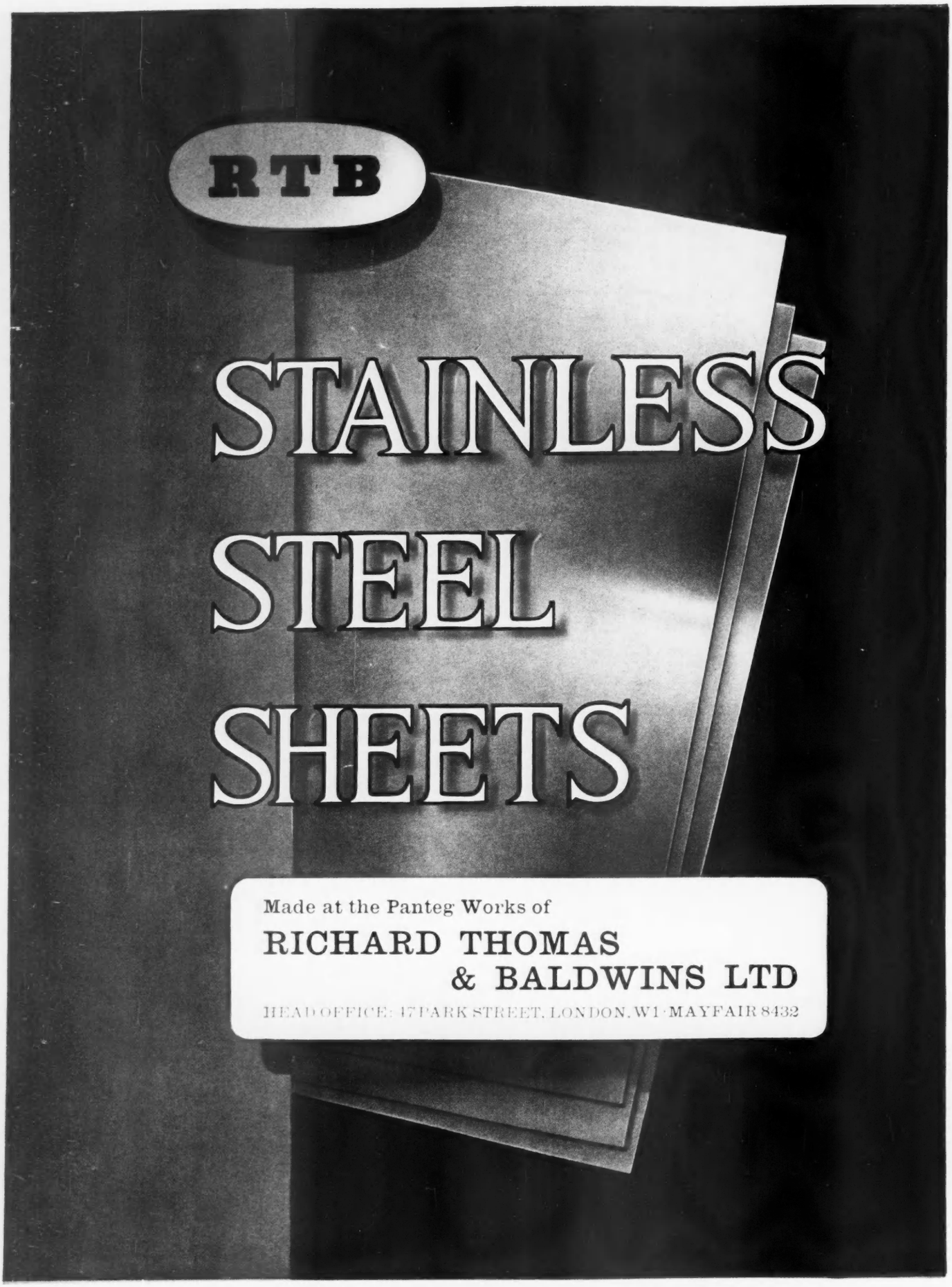
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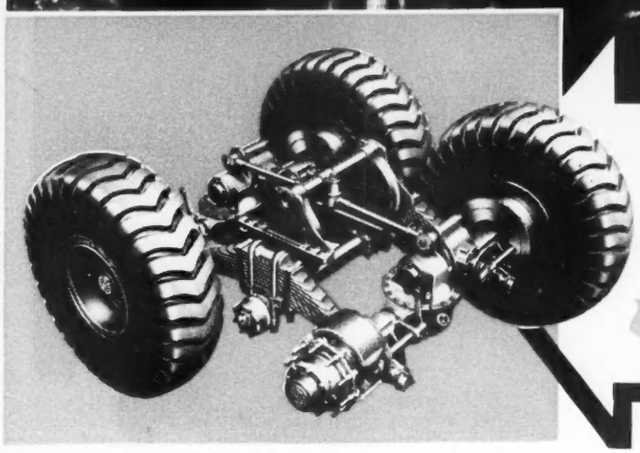

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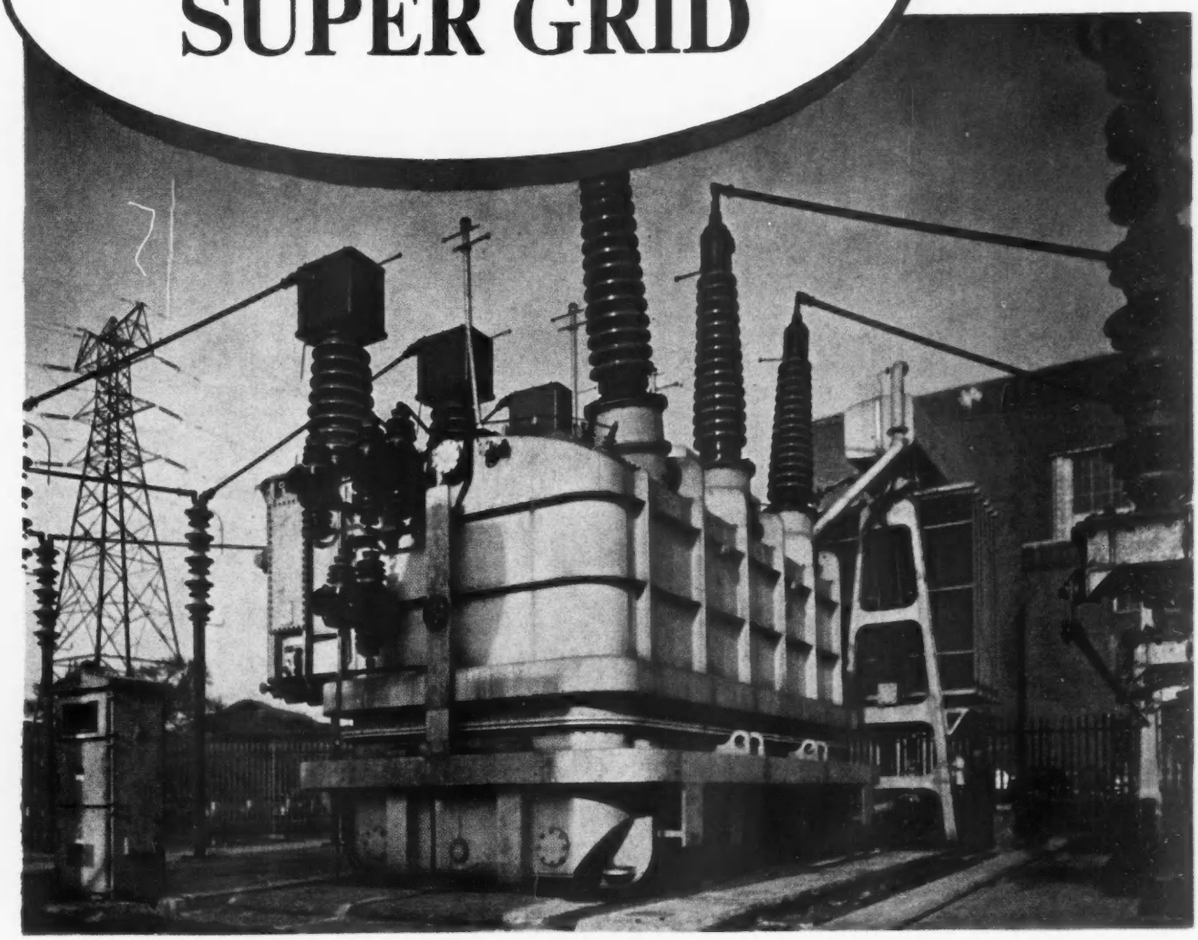

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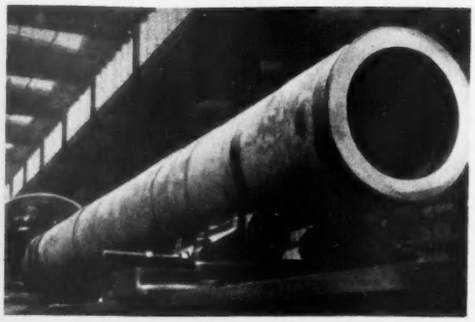

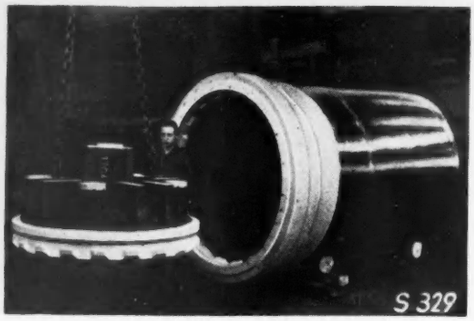

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A standard diesel engine ready to leave the fitting shops for use on British Railways. (*Nurnberg photograph for* ENGINEERING)

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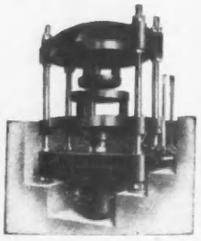

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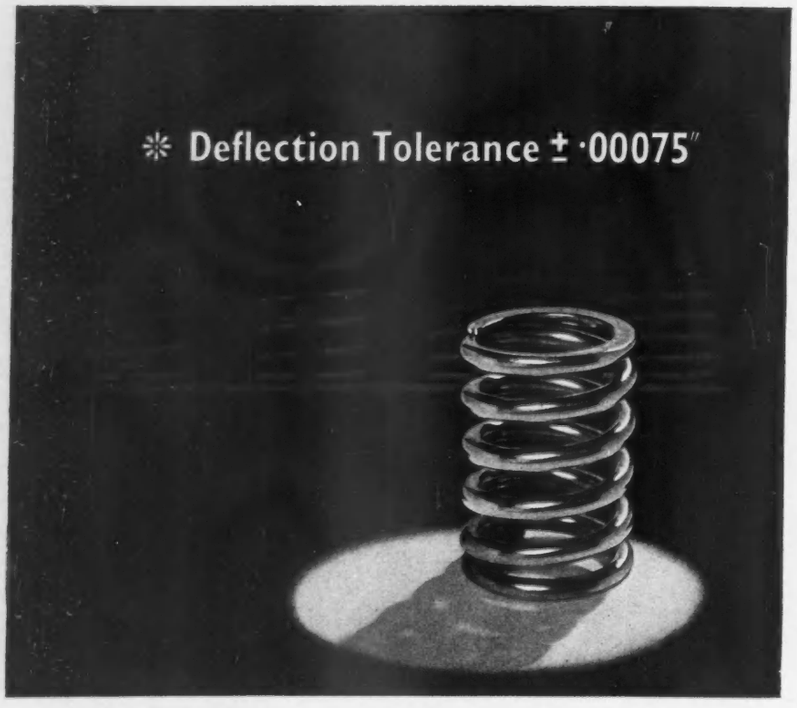

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CONTRACT NO. 4

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(1) PIERS AND FOUNDATIONS
(2) ABUTMENTS
(3) DECK INCLUDING GIRDERS AND ROADWAY

Copies of the Contract Documents may be obtained from the Consulting Engineers, Messrs. Mott, Hay and Anderson, 9 Iddesleigh House, Caxton Street, Westminster, London, S.W.1, on payment of a deposit of £10 by cheque made payable to the Forth Road Bridge Joint Board. The deposit will be repayable when a bona-fide Tender has been received. Prints of the Contract Drawings may also be obtained at the Tenderer's expense from the consulting Engineers.

Tenders must be sent in sealed plain cover marked "Tender for the Forth Road Bridge Contract" and addressed to THE CLERK, THE FORTH ROAD BRIDGE JOINT BOARD, CITY CHAMBERS, EDINBURGH 1, so as to be received there not later than 14th OCTOBER, 1960.

The Joint Board do not bind themselves to accept the lowest or any Tender.

W. BORLAND,
Clerk to the Forth Road Bridge Joint Board. C 673

INVITATION TO BIDDERS

REPUBLICA DE NICARAGUA
EMPRESA NACIONAL DE LUZ Y FUERZA MANAGUA

HYDROELECTRIC SYSTEM—TMV—FIRST STAGE

JULY 28, 1960.

The Empresa Nacional de Luz y Fuerza, an autonomous entity of the state, Republic of Nicaragua, announces that having obtained financing from the International Bank for Reconstruction and Development and from the Development Loan Fund for the construction of the first stage of the Tuma-Matagalpa-Viejo Hydroelectric System, will receive sealed bids addressed to the Construction Management of the same entity for the construction of the works described hereon, until the 18 HOURS of the 28th of OCTOBER of 1960.

CONTRACT No. TMV-IAL
PROJECT: TMV SYSTEM—FIRST STAGE
WORK: MANCOTAL DAM AND APPURTENANT WORKS.

Bids will be publicly opened and read aloud by the Construction Management of the Empresa Nacional de Luz y Fuerza in Managua at the 10 HOURS of 3rd of NOVEMBER of 1960.

Copies of the Contract Documents, plans and specifications may be examined and obtained upon the payment of C$450.00 or US$60.00 in the following places respectively:
(1) Empresa Nacional de Luz y Fuerza (Construction Management), Managua, Nicaragua.
(2) Electroconsult—13 Via Cavallotti, Milan, Italy.

Contract documents, plans, specifications and general information may be examined at the following places;
(1) Empresa Nacional de Luz y Fuerza (Construction Management), Managua, Nicaragua.
(2) Electroconsult S.p.A.—13 Via Cavallotti, Milan, Italy.
(3) Nicaraguan Embassy in Washington, U.S.A.—1627 New Hampshire Ave., N.W.
(4) General Consulate of Nicaragua in New York—1720 Ave. of the Americas Rockefeller Center, Suite 2 200, New York, N.Y.

The said work consists of the following:—
LOCATION: Work situated 20 kilometers N.W. of the City of Jinotega, Department of Jinotega, on the Tuma River.
DESCRIPTION: EARTH DAM AND EARTH DIKE: Homogeneous type resting on andesitic foundation; maximum height, 46 meters; crest length, 812 meters; total volume, 880,000 m³.
DIVERSION TUNNEL: 52 m². of cross section; length, 340 meters; concrete, 10,500 m²; reinforcing steel, 175 tons.
SPILLWAY: Uncontrolled "Morning Glory" type; maximum diameter, 26 meters; concrete, 400 m².; reinforcing steel, 40 tons.
DISCHARGE TUNNEL: Diameter, 7.5 meters; cross section, 46 m².; length, 267 m.; concrete, 3,000 m².; reinforcing steel, 200 tons. C 626

GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)
TENDER NO. S-8

The Ministry of Railways (Railway Board), Government of India, propose to purchase from established and reliable producers, a quantity of about 75,000 tons of Steel Materials such as Plates Sheets, etc.

The tender documents can be had on payment of £1 2s. 6d. per copy from The Director General, India Store Department, Government Buildings, Bromyard Avenue, Acton, London, W.3.

Tenders will be received by the DIRECTOR, RAILWAY STORES, RAILWAY BOARD, STATE ENTRY ROAD, NEW DELHI, INDIA, up to 12.000 hours on the 16th AUGUST, 1960, and opened in the office of the RAILWAY BOARD ON STATE ENTRY ROAD, NEW DELHI, on the same day. C 665

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1 No. 250 kW Diesel driven alternator Set, and
1 No. mechanical type circulating water cooler suitable for use with this machine.

Tender documents and Specifications for the Contract may be obtained from the Resident Engineer, Electricity Corporation of Nigeria, c/o Adelphi, John Adam Street, London, W.C.2.

Each Tender must be enclosed in a sealed envelope marked "Confidential—Tender for 250 kW Diesel Alternator Set—Maiduguri" and must be received at the office of the SECRETARY, ELECTRICITY CORPORATION OF NIGERIA, ELECTRICITY HEADQUARTERS, 13, BROAD STREET, PRIVATE MAIL BAG 2030, LAGOS, not later than noon on SATURDAY, 20th AUGUST, 1960. Tenders received in any other manner will not be considered.

The Electricity Corporation of Nigeria does not undertake to accept the lowest or any tender.

Further information concerning this Contract may be obtained on application to the RESIDENT ENGINEER, LONDON.

GEORGE W. NICOL,
ACTING SECRETARY TO THE CORPORATION. C 628

FOR SALE OR HIRE

600

NEW/UNUSED 979 kVA 6600 volts 3 phase 50 cycles **DIESEL ENGINE DRIVEN ALTERNATOR SET,** incorporating 1120 h.p. 16-cylinder engine by MIRRLEES BICKERTON & DAY, type JV.16. Direct coupled at 750 r.p.m. to alternator by BRUSH ELECTRICAL, revolving field, with exciter and switchgear by REYROLLE.

625 kVA 400/440 volts 3 phase 50 cycles **DIESEL ENGINE DRIVEN ALTERNATOR SET,** incorporating 800 h.p. 8-cylinder 2-stroke engine by CROSSLEY, type HSL.8. Direct coupled at 500 r.p.m. to alternator by G.E.C., revolving field, with direct coupled exciter and switchgear.

375 kVA 400 volts 3 phase 50 cycles **DIESEL ENGINE DRIVEN ALTERNATOR SET** incorporating 380 h.p. horizontal 4-cylinder engine by BLACKSTONE, type 4M13. Direct coupled at 333 r.p.m. to alternator by BRUSH ELECTRICAL, screen protected with direct coupled exciter and switchgear.

TWO 250 kVA 400/440 volts 3 phase 50 cycles **DIESEL ENGINE DRIVEN ALTERNATOR SETS,** each incorporating vertical 6-cylinder engine by CROSSLEY BROS., type XVD.6. Direct coupled at 600 r.p.m. to alternator, one by BRITISH THOMSON HOUSTON, the other by METROPOLITAN VICKERS, with direct coupled exciter and switchgear.

180 kVA 400 volts 3 phase 50 cycles **DIESEL ENGINE DRIVEN ALTERNATOR SET** incorporating vertical 3-cylinder engine by MIRRLEES BICKERTON & DAY, type J.3. Direct coupled at 750 r.p.m. to alternator by BRUSH ELECTRICAL, with direct coupled exciter and switchgear.

145 kVA 400 volts 3 phase 50 cycles **DIESEL ENGINE DRIVEN ALTERNATOR SET** incorporating vertical 5-cylinder engine by BLACKSTONE, type EPV.5. Direct coupled at 500 r.p.m. to alternator by CROMPTON PARKINSON, with direct coupled exciter and switchgear.

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STANNINGLEY, NR. LEEDS.
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Edwards

BESCO UNIVERSAL SWING BEAM FOLDING MACHINE. Capacity 6 ft. 2 in. by ¼ in. Clamping beam swings out for withdrawal of trunk sections. Folding beam adjustable for sharp and round bends. With adjustable stop for repetition bending and adjustable back gauge. Weight approx. 6300 lb.

CRAIG & DONALD DEEP GAP GUILLOTINE SHEARING MACHINE. Motorised for 440/3/50 supply. With automatic hold-down and adjustable back gauge. Capacity 14 ft. by ¼ in. Complete with three spare sets of blades. Weight approx. 11 tons.

BENNIE 4-ROLL PLATE BENDING AND STRAIGHTENING MACHINE. Motorised for 440/3/50 supply. Capacity 4 ft. by ⅜ in. Top roller bearing swings down for withdrawal of cylinders. Diameter of bending roller 7½ in., diameter of straightening roller 6 in. Weight approx. 4½ tons.

BESCO UNIVERSAL NIBBLER-SHEARING MACHINE. Motorised for 380-420/3/50 supply. Capacity mild steel ½ in. Depth of throat 42 in. Cuts rings or discs up to 42 in. diameter. Cutting speed 3 ft. 6 in. per minute. Weight approx. 35 cwt.

SEDGWICK MOTORISED PRESS BRAKE, for 440/3/50 supply. Capacity mild steel 6 ft. by ⅛ in. Bed 76 in. long by 4½ in. wide. Depth of gap 15 in. Between side frames 41 in. Weight approx. 6 tons.

BESCO HIGH DUTY GUILLOTINE SHEARING MACHINE. Motorised for 400-440/3/50 supply. With automatic hold-down and adjustable front, back and side gauges. Capacity mild steel 96 in. by ¼ in. Weight approx. 120 cwt.

RHODES MOTORISED PRESS BRAKE. For 400/3/50 supply. Pressure exerted 150 tons. Forming capacity 10 ft. by ⅛ in. or 18 ft. by approx. ¼ in. Between housings 10 ft. 2 in. Stroke 5 in. Depth of gap in open ends 11 in. Weight approx. 20 tons.

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For 'Engineering' Appointments Section, turn to the centre of editorial section. B2

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PATENTS

THE PROPRIETORS OF PATENT NO. 774048, for "ELASTIC FITTING FOR GEARS PROVIDED WITH AT LEAST ONE SERIES OF TEETH," desire to secure commercial exploitation by Licence or otherwise in the United Kingdom.—Replies to Haseltine Lake & Co., 28, SOUTHAMPTON BUILDINGS, CHANCERY LANE, LONDON, W.C.2. C 683

THE PROPRIETORS OF PATENT NO. 750342 for "IMPROVEMENTS IN OR RELATING TO ELASTIC STAPLE ELEMENT STRIP" desire to secure commercial exploitation by Licence or otherwise in the United Kingdom.—Replies to Haseltine Lake & Co., 28, SOUTHAMPTON BUILDINGS, CHANCERY LANE, LONDON, W.C.2. C 627

TRANSLATION

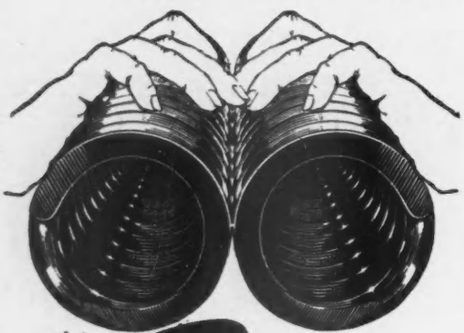
TRANSLATIONS, CATALOGUES, ESTIMATES, etc., from/into **FRENCH/ENGLISH.** Rec. by Brit. Council and Brit. C. of C. Paris.—BOX G 891, Offices of ENGINEERING.

NORTH ACTON
AUCTION SALE OF FREEHOLD FACTORY
20th September, 1960

Debenham Tewson & Chinnocks announce that the Auction Sale will not now take place of the Freehold Factory at North Acton occupied by Light Alloys Limited, the premises having been sold by private treaty.

C653

Looking in the right direction



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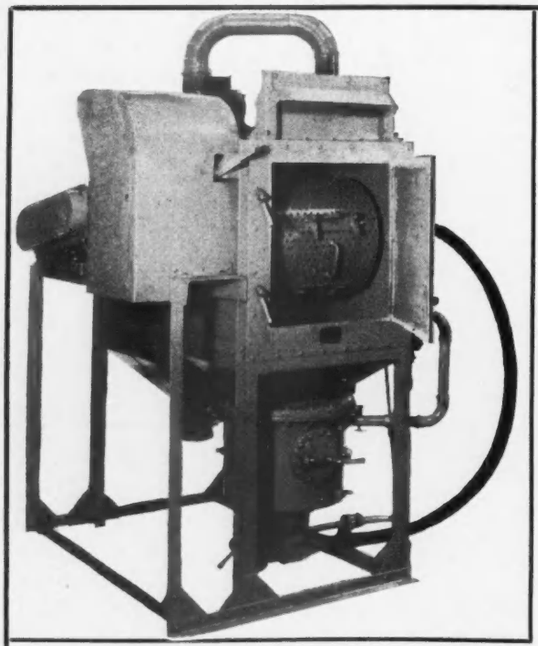

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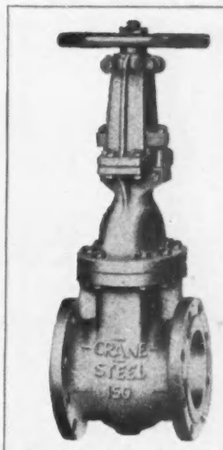
ONCE AGAIN VALVES BY CRANE

The new plant of The International Synthetic Rubber Company Ltd. at Hythe on Southampton Water is now in production in a big way. Once again Crane valves are playing an important part. The illustration *left* shows the recovery building, where the steam lines to the Styrene Strippers have been fitted with Crane 12 inch, 10 inch and 6 inch cast steel gate valves. In the administrative buildings too, Crane equipment is used, the central heating and domestic installations being very largely fitted with Crane Bronze Globe and Gate Valves. More and more industries are discovering that the name of Crane is synonymous with dependability.

INSTALLING ENGINEERS:
Matthew Hall & Co. Ltd., London



One of the valves used—the 47X in cast steel, with end connections to British as well as American Standards. Can be trimmed to suit a variety of services for high and low pressures and temperatures.

D30

CRANE

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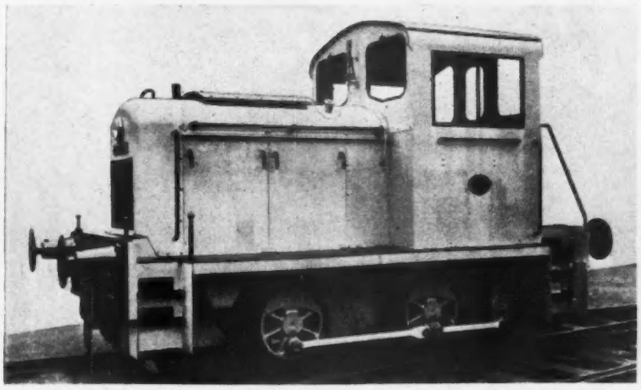
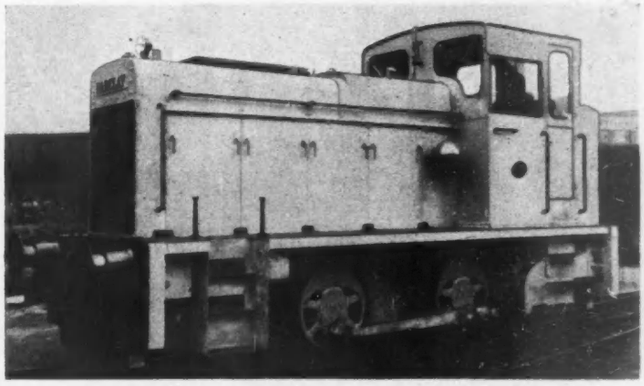
Andrew Barclay have two new locomotives available for immediate delivery



1. 85 h.p. 0-4-0 Diesel Hydraulic Locomotive, fitted with Dorman diesel engine and a Twin Disc hydraulic torque convertor. Maximum speed about 10 m.p.h., maximum tractive effort 8,160 lbs.



2. 233 h.p. 0-4-0 Diesel Hydraulic Locomotive fitted with Rolls-Royce diesel engine and Twin Disc hydraulic torque convertor. Maximum speed is about 14 m.p.h., maximum tractive effort is 21,750 lbs.

These locomotives were manufactured alongside our current production batches in an endeavour to meet the growing demand for early delivery and are ready for finish painting to customer's requirements. Photographs and specifications are available on request.

Barclay Locomotives in production or recently delivered, include twenty Diesel Mechanical units for British Railways, six Diesel Hydraulic models for the C.E.G.B. and several single locos to customer's requirements.

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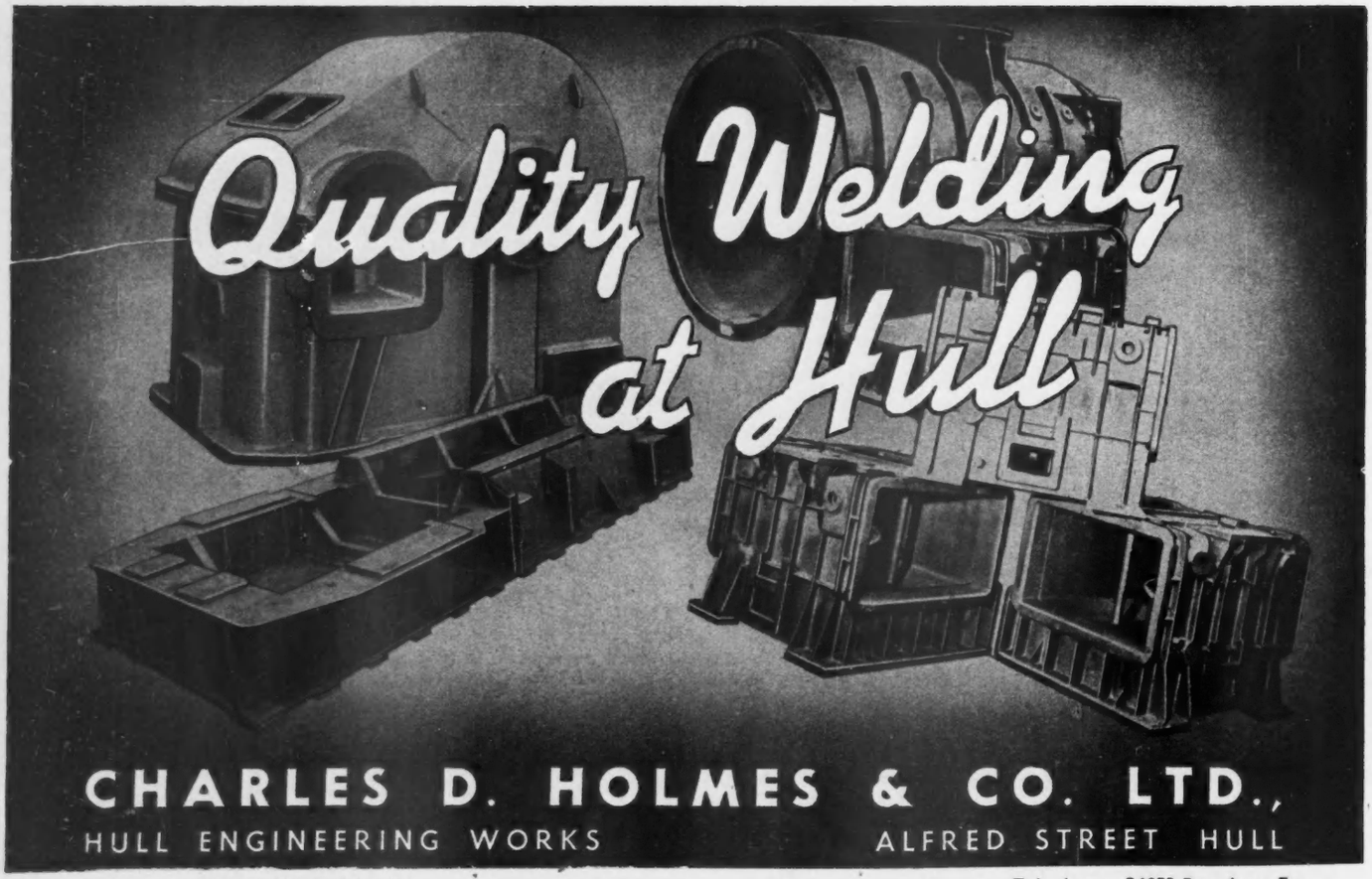
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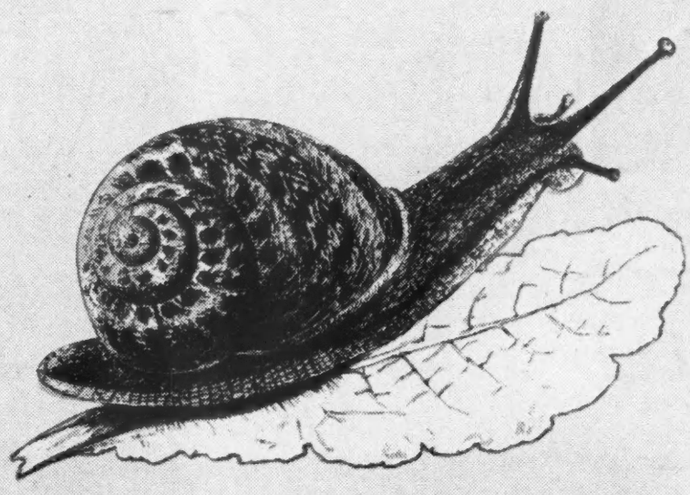

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● Steel, in fact, made to measure—to your exact requirements.

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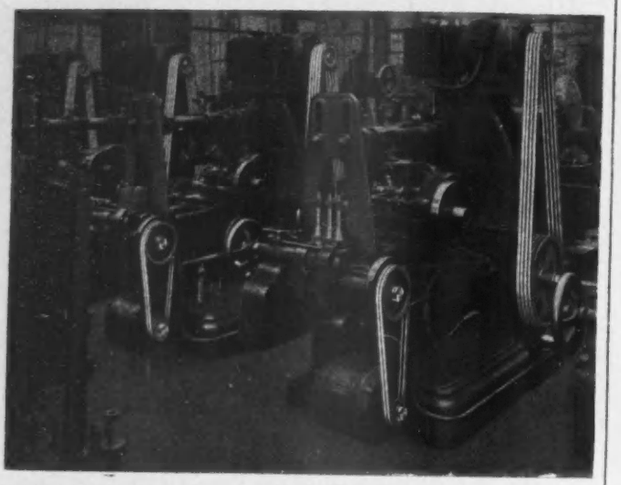

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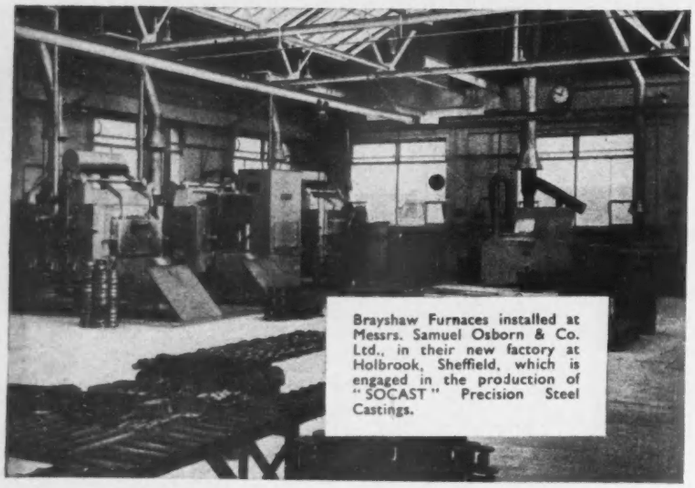

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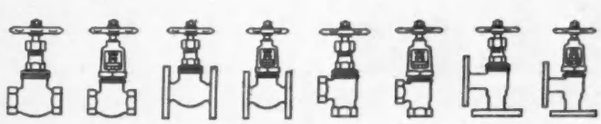

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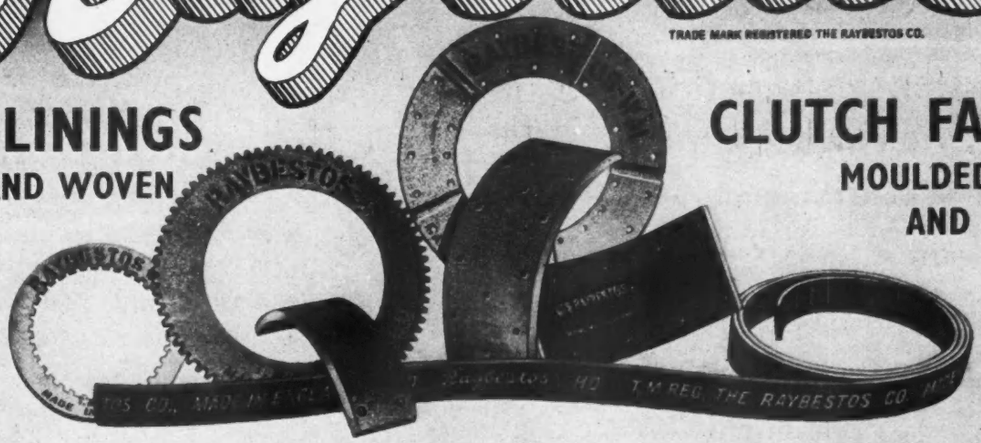

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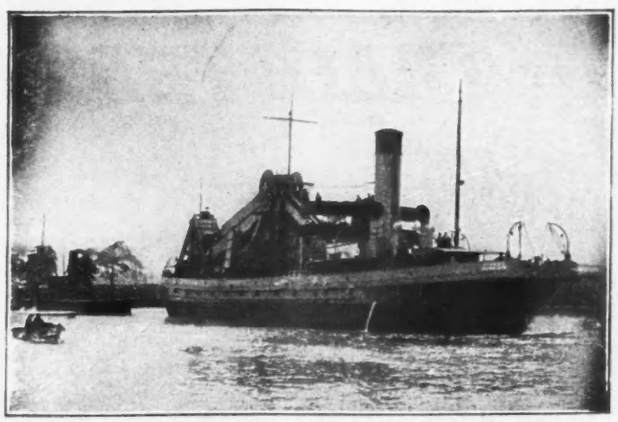

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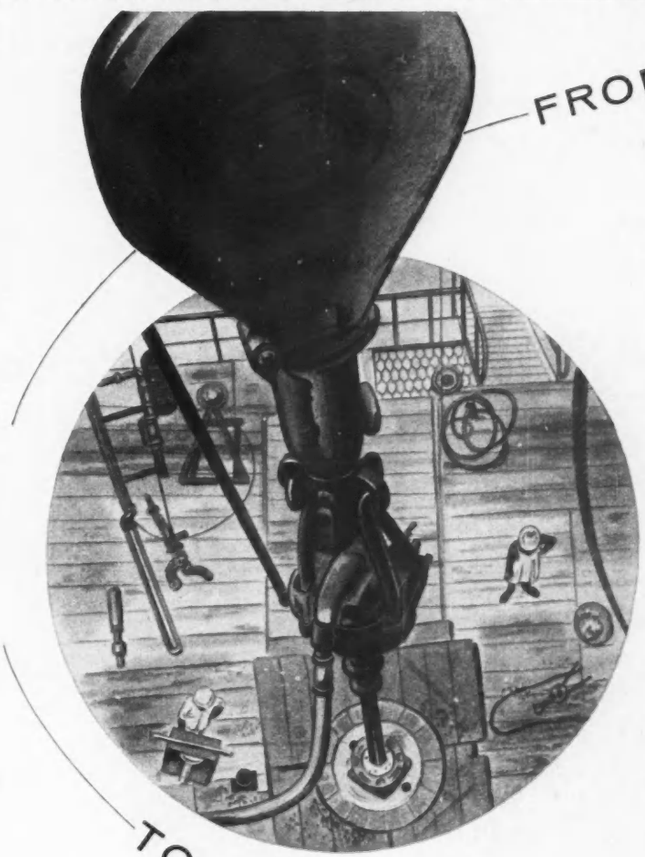

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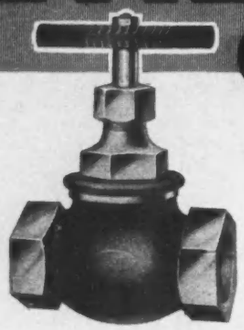

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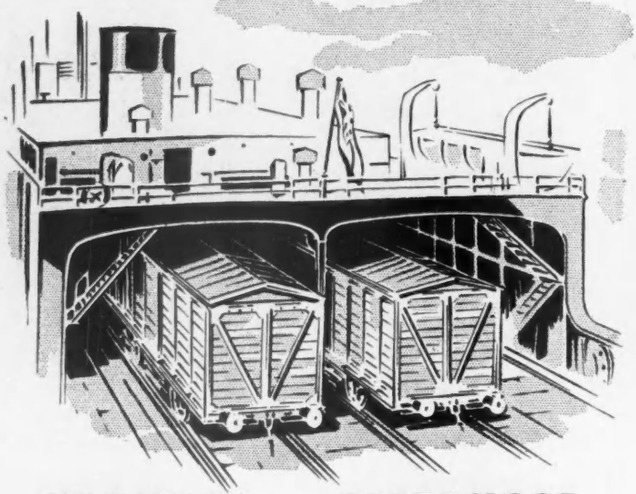

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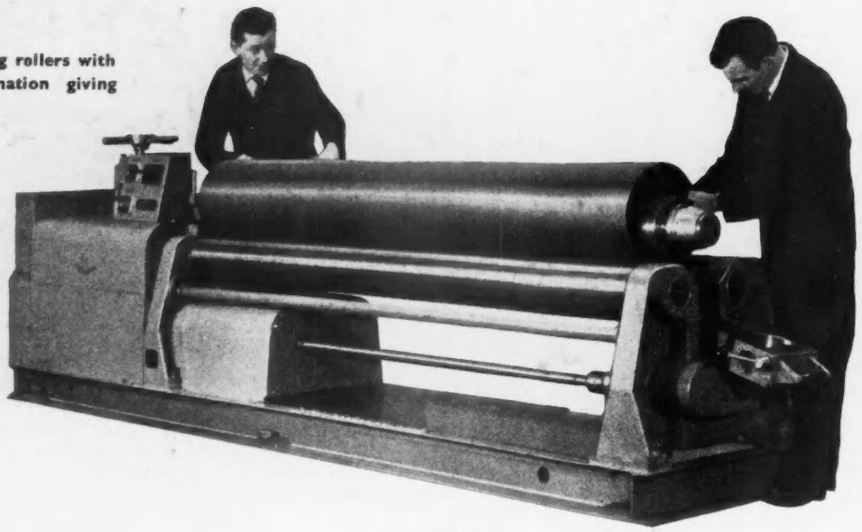

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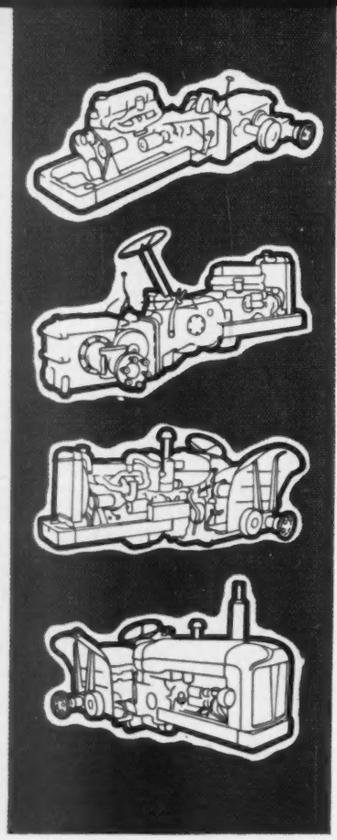

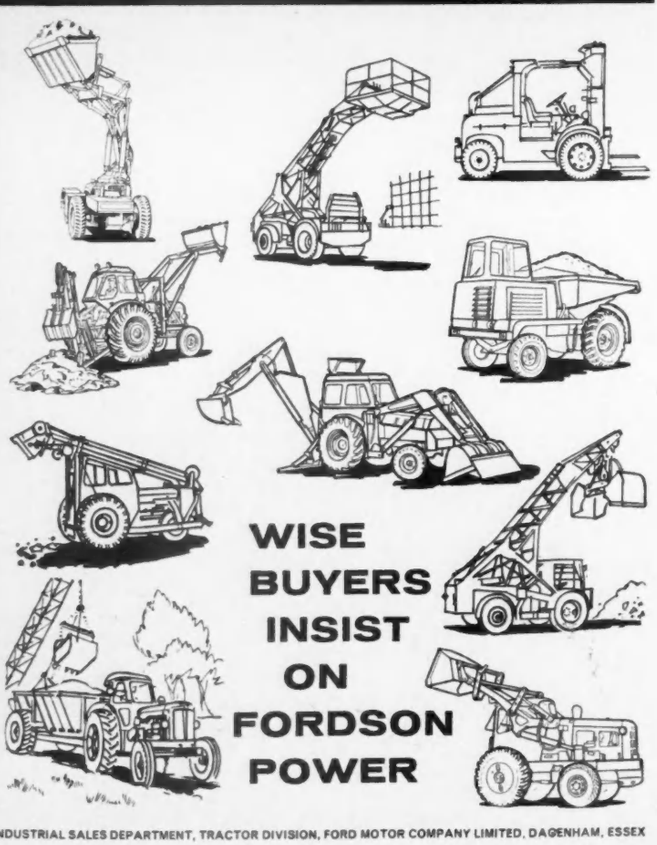

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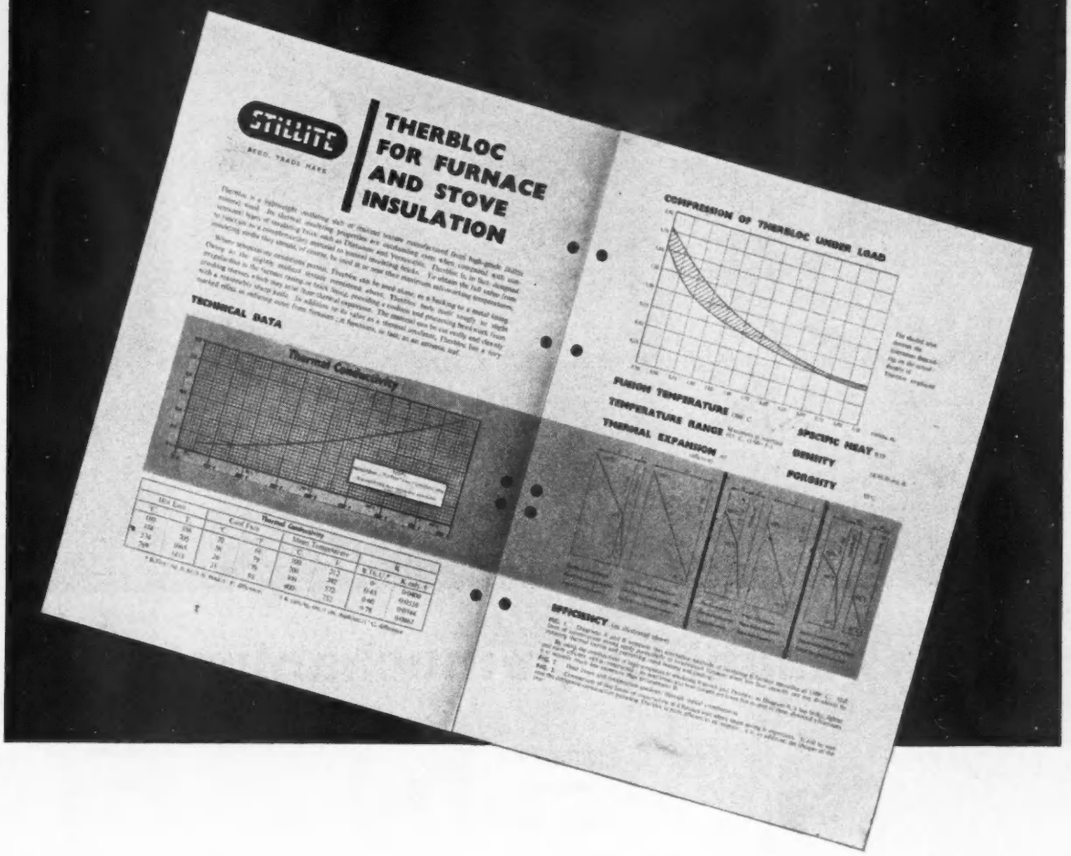

this New Data Sheet gives the factors required to calculate the saving in heat obtainable with Therbloc mineral wool insulation used either by itself or as a backing to refractories or insulating brick. Graphs of 'K' values and practical examples are included.

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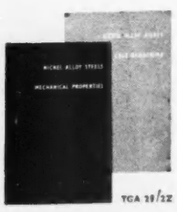
SIZE	HEAT TREATMENT	MAXIMUM STRESS t.s.i.	ELONGATION per cent	IZOD ft. lb.
1⅛" dia.	Oil quenched 780°C.	72·0	19	69
2½" dia.	Oil quenched 860°C.	62·7	19	67
	Oil quenched 780°C.			
3" dia.	Oil quenched 860°C.	59·7	22	72
	Oil quenched 780°C.			

The benefits to be gained from the more highly alloyed case-hardening nickel steels, such as EN 33, EN 34, EN 36 and EN 39 include ease of heat-treatment, minimisation of processing distortion, and general reliabilitity.

Please send for our publications entitled, 'The Mechanical Properties of Nickel Alloy Steels' and 'The Case Hardening of Nickel Alloy Steels'



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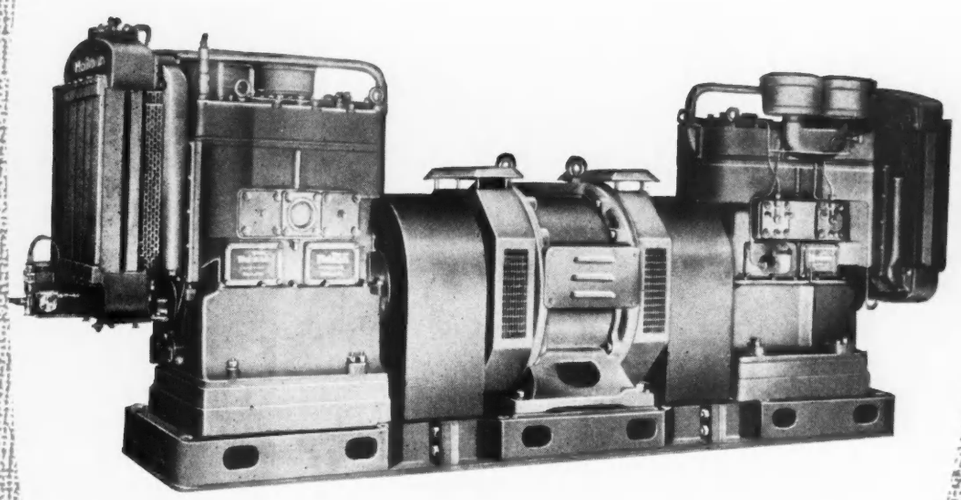

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Powerful . . .

smooth-running . . .

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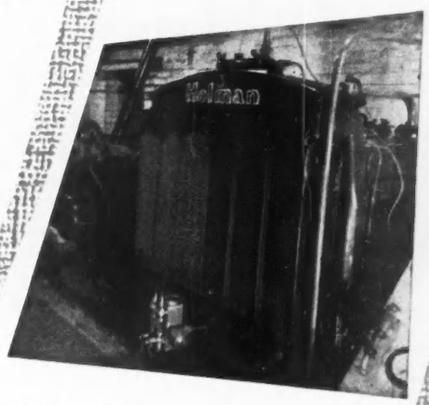
The Holman Duplex Stationary Compressor . . .

Ideal for in-bye use



Holman design, Holman strength, Holman *efficiency*—you get all these in this new stationary compressor arrangement. And you will find something more—the Duplex set allows almost vibrationless running. Made in two versions, the Duplex features a centre-mounted electric motor (156 or 230 b.h.p.) and twin T60R or T36R compressors. The two models give respectively 1050 or 610 cubic feet a minute at 100 p.s.i. with a maximum of up to 150 p.s.i. The compressor units used are of the well-known Holman two-stage, reciprocating type, with closed-circuit cooling and pressure-oiled bearings.

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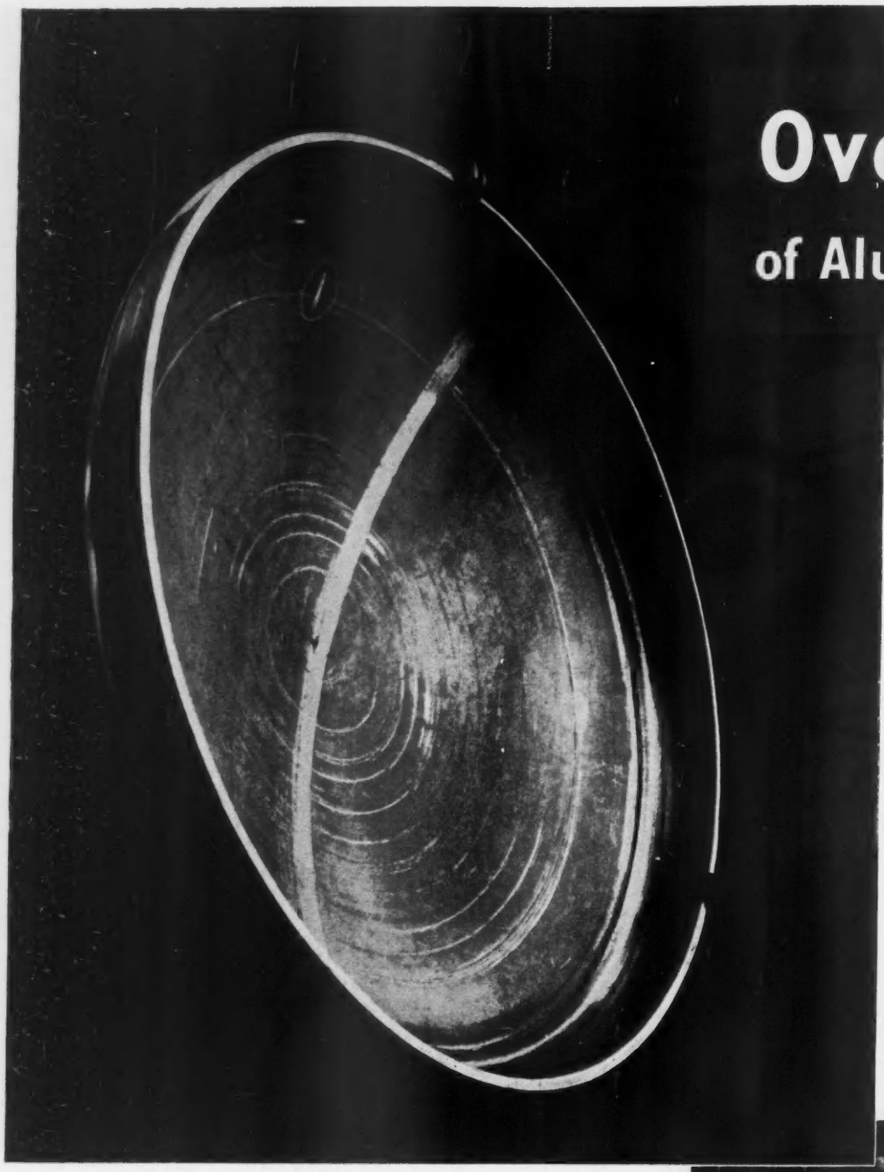
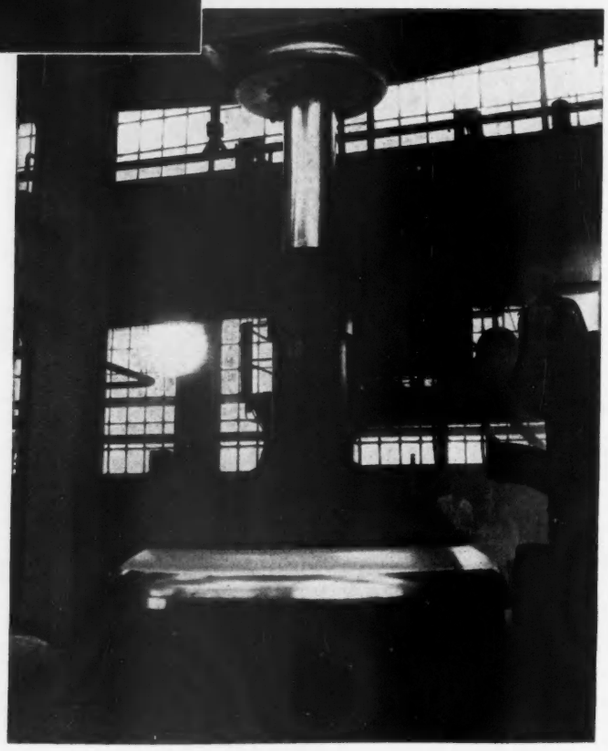


Over a Ton of Aluminium Alloy

spun to 10 ft. i/d x $1\frac{5}{8}$"

One of a number produced for pressure vessels to hold liquid air, this 10 ft. aluminium end was spun by Harveys on the Rotarpress. The 12 ft. flat discs needed for spinning these ends, which are believed to be the largest spun aluminium ends produced in this country, were formed by butt-welding two plates of aluminium alloy together.



The Rotarpress is one of the large-capacity units in Harveys Heavy Fabrication Department. It produces ends up to 15 ft. diameter and is adaptable over a wide range of knuckle radii and depths.

The contours of semi-ellipsoidal ends produced by the spinning process enable plate thickness to be reduced, and in most cases tool costs are eliminated. Enquiries are invited for ends only or for complete

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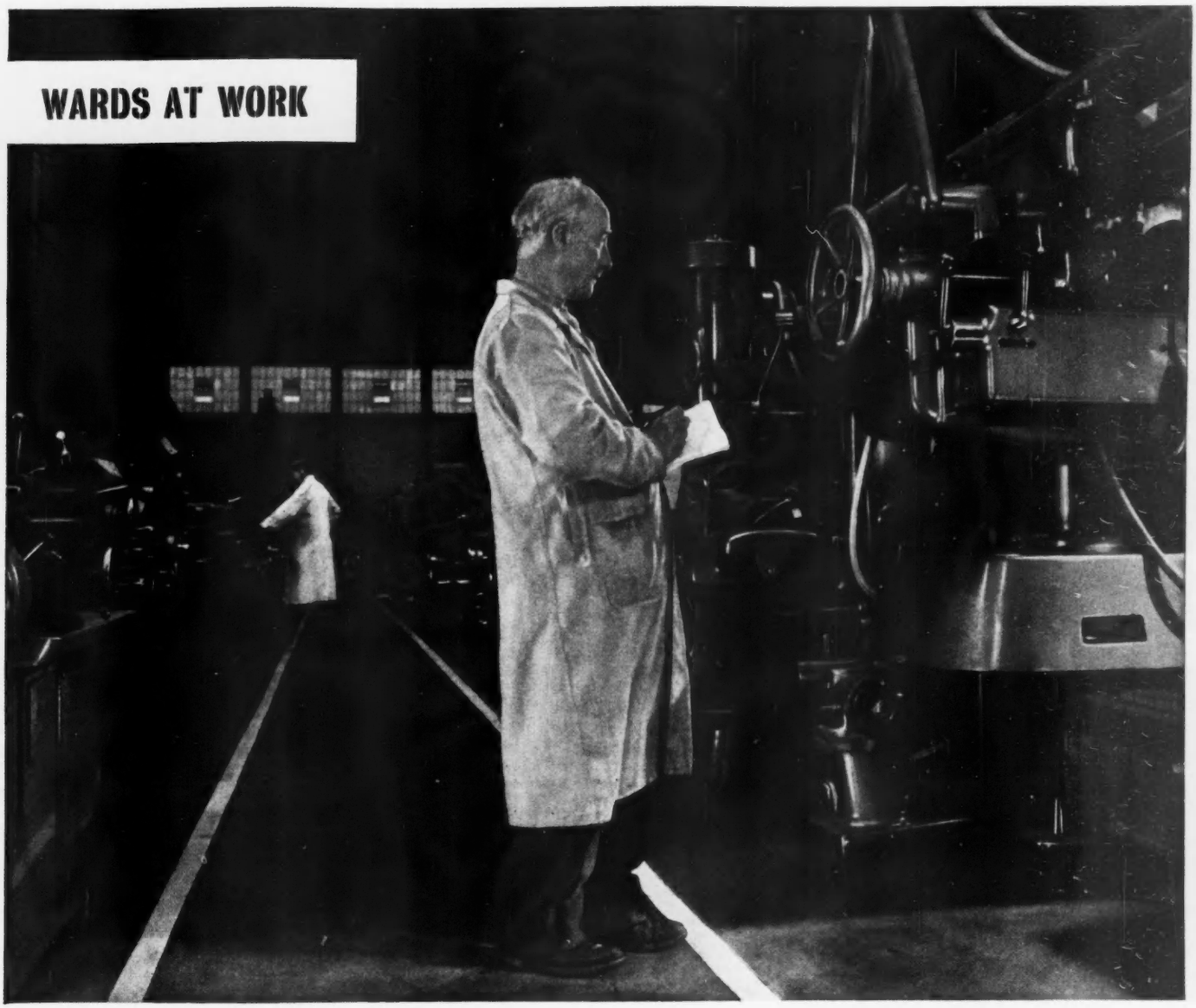

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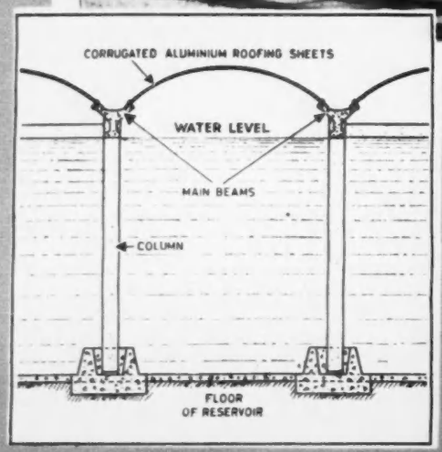

Please write for Morris Mobile Crane Brochure 546

with two M120 Diesel Electric
MOBILE CRANES

The Morris 6 ton mobile cranes illustrated, are erecting the columns and the main beams which will support the aluminium sheet roof of a 16 million gallon concrete lined reservoir now being constructed at Weeton, Lancs., for the Fylde Water Board. Each crane has a 35ft. jib made up of two 15ft. sections and one 5ft. centre section.

The cranes lend themselves admirably to a somewhat unusual situation involving partial dismantling, so that they can be passed through an 8ft. wide culvert leading to the floor of the reservoir basin where they are seen operating. Although, in this instance, the cranes are shown fitted with strut jibs, the Morris range of mobiles embraces cranes with cantilever jibs, truck and lorry mounted types up to 6 tons capacity in addition to similar alternative range for loads up to 3 tons.

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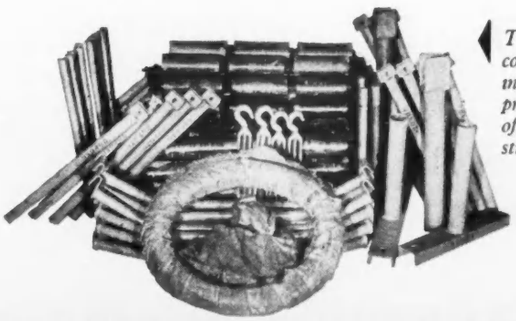
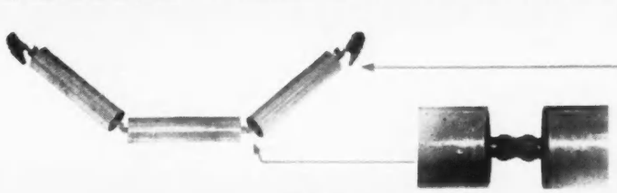


This group of components—stacked in an area of 28 sq. ft.—produce 200 ft. of this conveyor structure . . . .

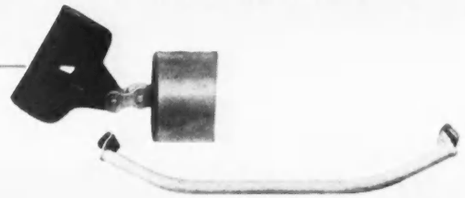
DISTINGTON-GOODMAN

ROPE BELT

CONVEYOR STRUCTURE
patented



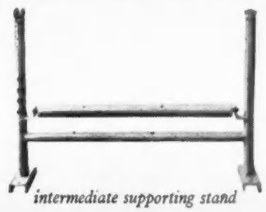
swivel links are fitted at each end of an idler shaft



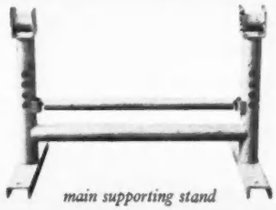
stretchers are used at intervals between stands

RESILIENT

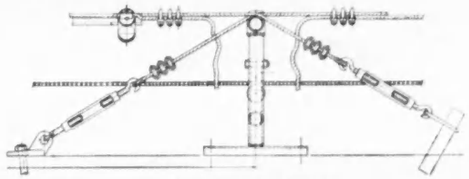
- *increases belt life*
- *reduces installation costs*
- *increases capacity*
- *almost eliminates spillage*
- *inexpensive*



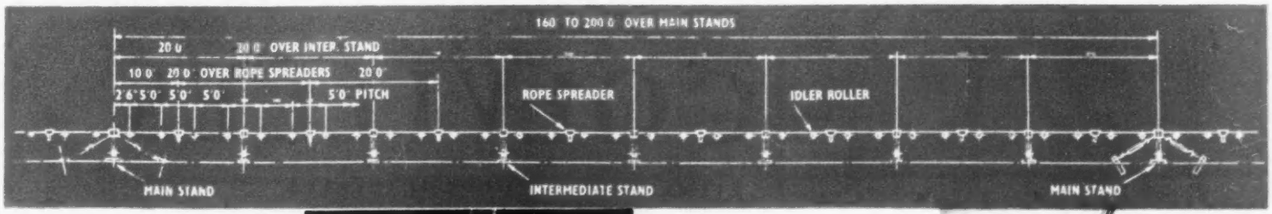
intermediate supporting stand



main supporting stand

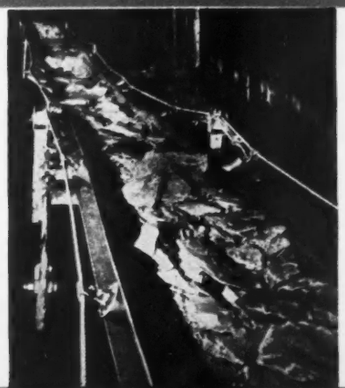


typical rope anchorages



Installation, extension and contraction of Distington-Goodman Rope Belt Conveyor Structure is relatively quick and easy.

(Right) Detail of a main stand and anchor point. These can be spaced up to 400′ apart according to requirements.



A 36″ rope belt conveyor installed at a quarry, carrying 500 tons of gravel per hour. By securing the rope to terminal pulleys it has proved practicable to move this conveyor bodily sideways by the dragline shown in the illustration.

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DISTINGTON

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First 200 MW generating unit in Britain

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Steam Conditions:	Pressure	2,350 p.s.i.g.
	Temperature	1,050°F
	Reheat Temperature	1,050°F

Also in course of manufacture for the Central Electricity Generating Board are:—

Two 275 MW single-line units for Blyth 'B' station
Two 350 MW single-line units for Drakelow 'C' station

AND NOW . . . Instructions have been received to put in hand TWO 350 MW single-line units for Blyth 'B' station.

'ENGLISH ELECTRIC'

steam turbo-alternator sets

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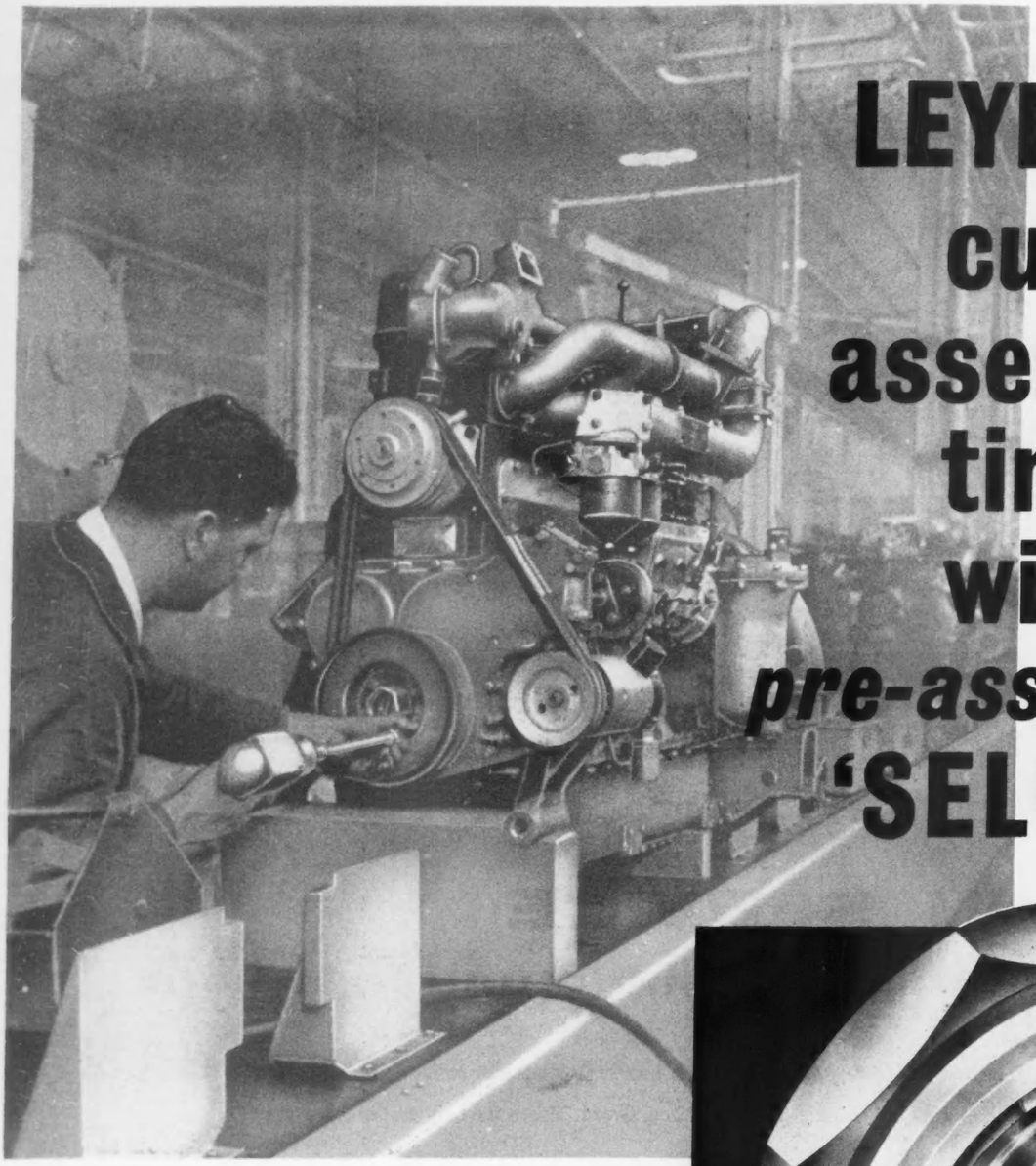
Steam Turbine Division, Rugby

ST.39 WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON



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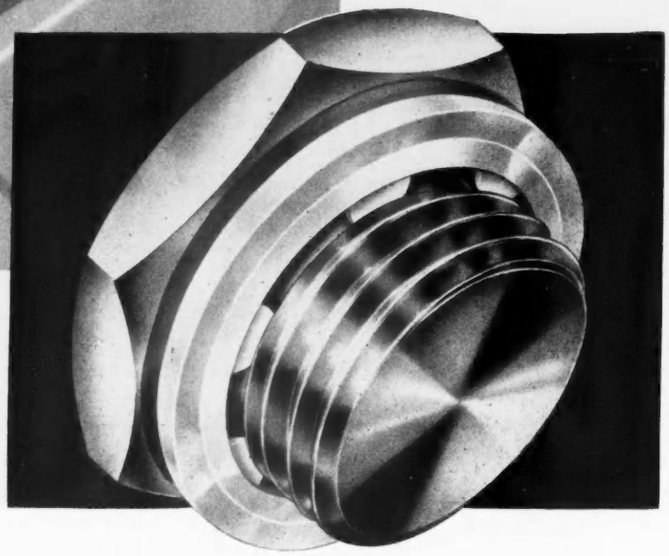

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For efficient sealing and speedy assembly, Leyland Motors use these pre-assembled nylon captive sealing washers.

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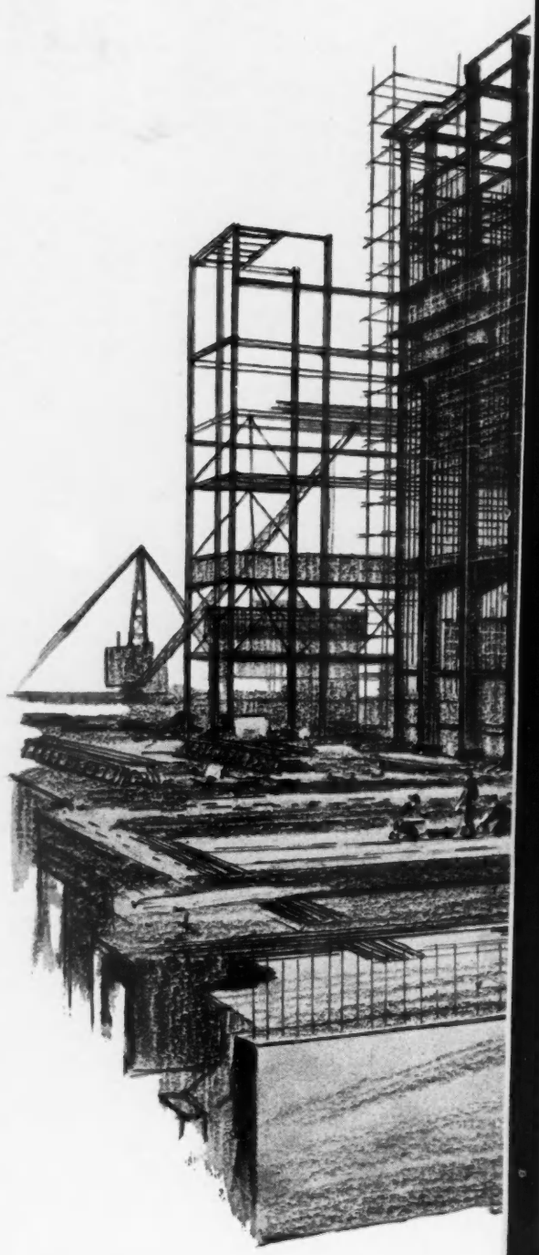

ENGINEERING CONSULTANTS: Ewbank & Partners, Ltd., 10/11 Grosvenor Place, London, S.W.1.

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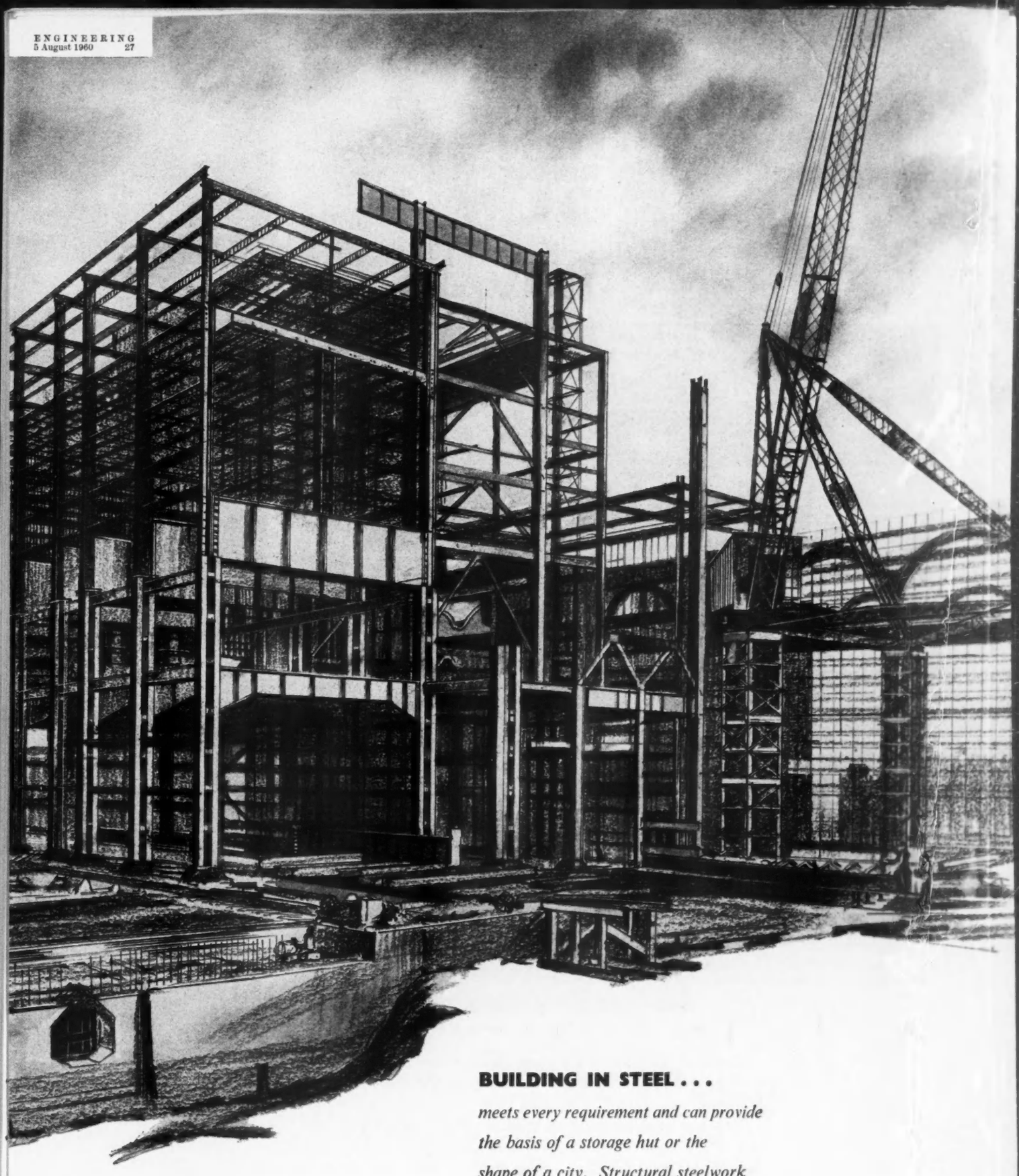

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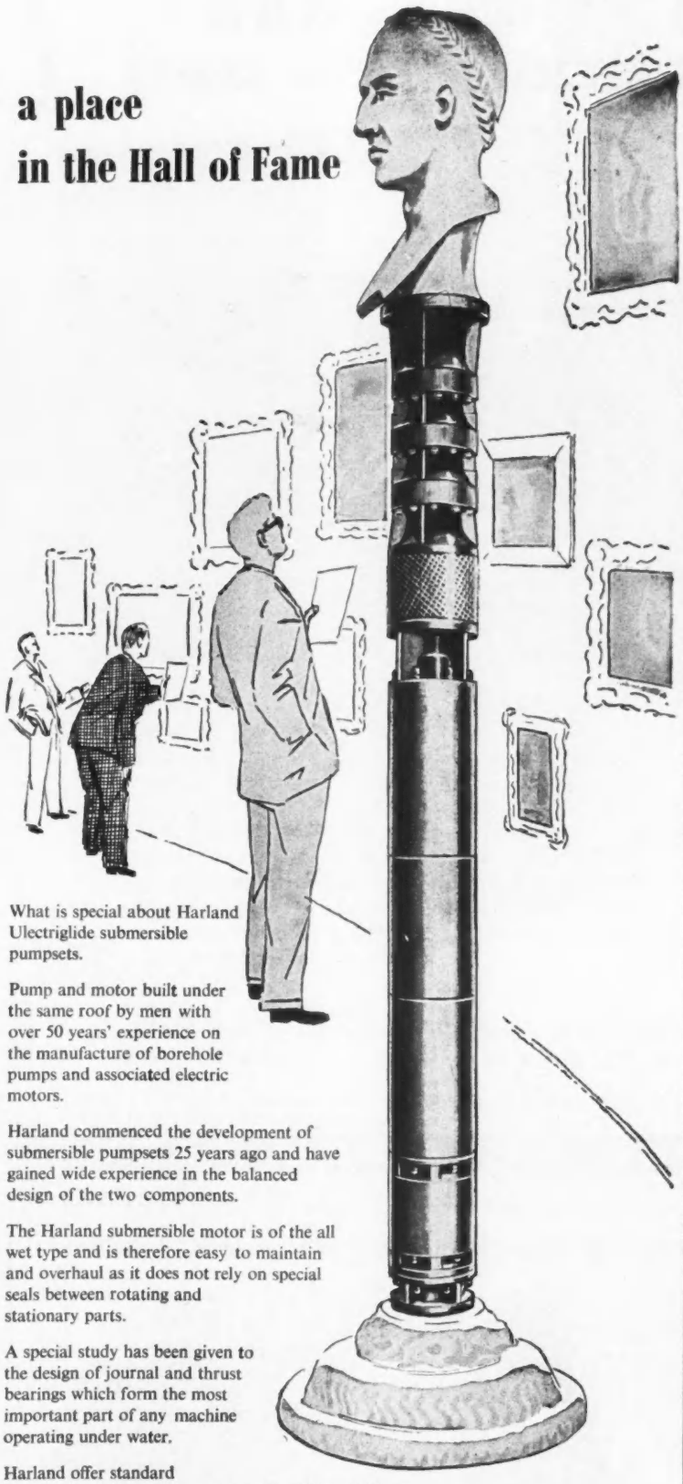

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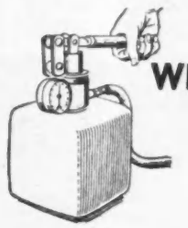

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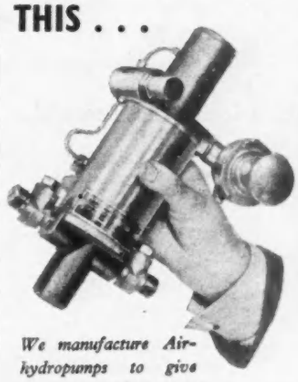

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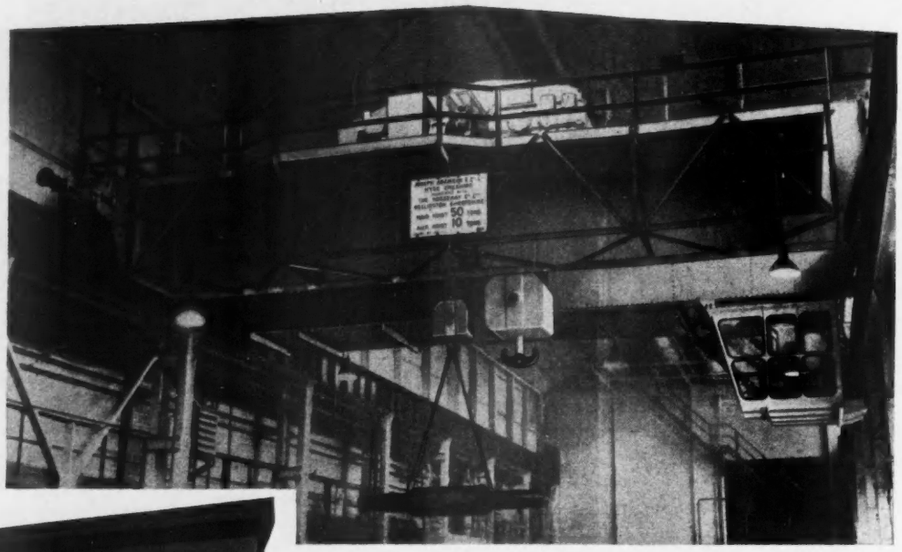

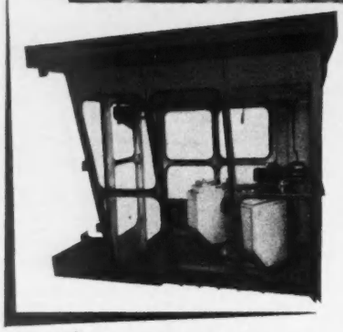

★ *a view of the cab showing the seat control unit.*

The Adamson 50/10 ton crane is the third of a series of new design supplied to Richard Thomas & Baldwins Limited, Ebbw Vale Section. Features of the crane include monolithic construction of the crab and the elimination of castings by mild steel fabrication of the hoist barrel and bottom block. The cab is of particular interest as it incorporates the most modern type of seat unit ensuring maximum visibility and ease of control. Joseph Adamson electric overhead travelling cranes can be supplied to all specifications including cranes suited to the most exacting 24 hours-a-day process work.

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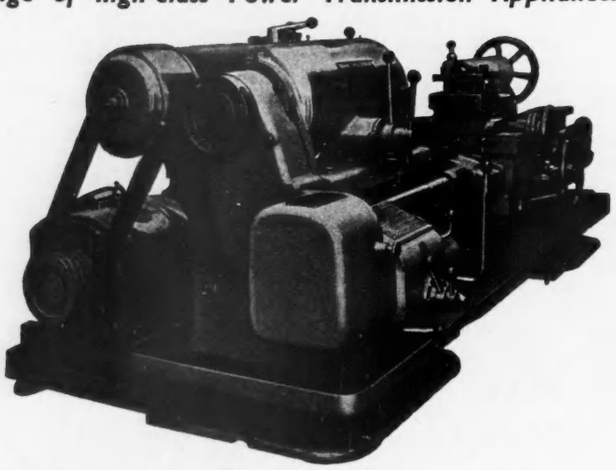

The photograph shows one of our drives mounted on a Denham Model SS8 heavy duty centre lathe.

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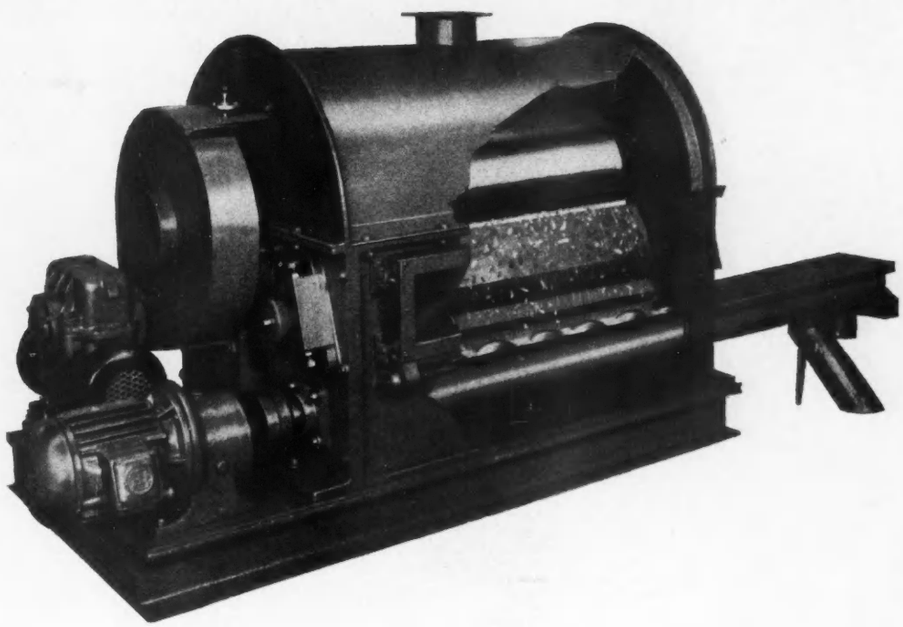

In constant production in a large number of sizes ranging from 8in. dia. by 8in. long to 42in. dia. by 108in. long. Rolls are constructed of cast iron, chromed cast iron, nickel iron, stainless steel, phosphor bronze, etc.

Machines have been supplied to leading chemical manufacturers at home and abroad for flaking such materials as naphthalene, phthalic anhydride, carbamite, stearines, waxes, etc., etc.

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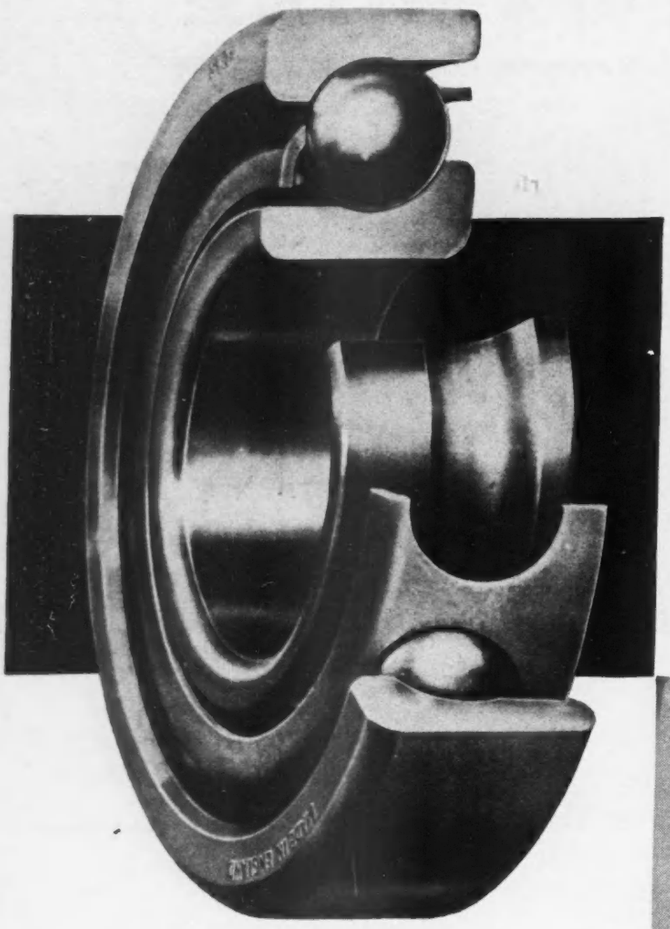
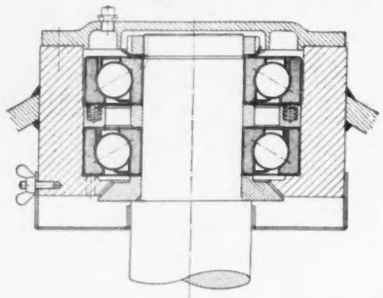
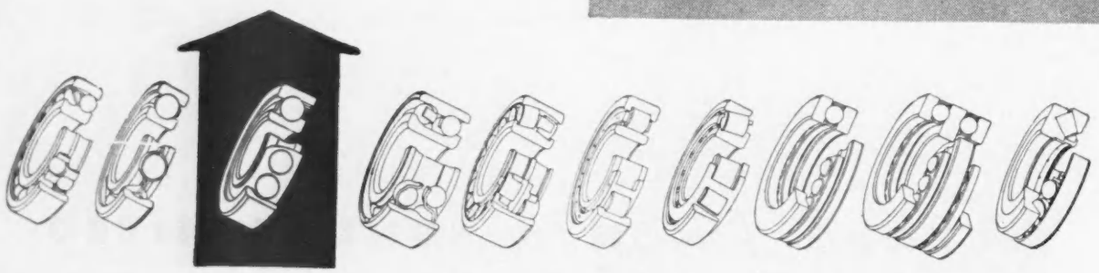


In the single row angular contact ball bearing, the line joining the ball contact points forms an acute angle with the bearing axis. Bearings of this type are therefore particularly suitable for carrying both radial and heavy axial loads, being used in conjunction with a similar bearing dealing with axial forces in the reverse direction.

The problem of which type of bearing to use under given design conditions can be readily solved by utilising the immense fund of technical knowledge which is freely available to you from SKF. The Skefko Ball Bearing Co. Ltd., the only British manufacturer of all four basic types of ball and roller bearing, can offer advice which is completely unbiassed by manufacturing considerations.



Top bearing for vertical electric motor



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ENGINEERING Impact

of American Straws in the Wind

AMERICAN subsidiaries set up in Britain may help to show which way the wind is blowing. To some extent they can operate more freely than native companies, and hence respond more readily to economic breezes. Like resonant circuits they amplify existing trends in marketing and production, and are inclined to speak their minds on matters of common interest when British firms may tend to be more reticent.

Speaking last week in Northern Ireland, Mr. Walter S. Carpenter Jr., chairman of the American Du Pont company, remarked "As we look forward and appraise prospects on a somewhat broader scale, we are conscious of the presence here in Europe of two important but distinct economic areas—the Common Market and the Free Trade area. In this connection we are conscious of the benefits which would flow to this enterprise and other businesses from an ever greater cooperation, conceivably eventual merger, of these two great trade areas. This development could also contribute to the enlargement of the Maydown Works to embrace the manufacture of other products." The Maydown Works, which was being opened by Lord Wakehurst, Governor of Northern Ireland, has been built for the Du Pont Company (United Kingdom) Limited to produce their synthetic rubber, neoprene.

Common Market Pressures

Asked by a representative of ENGINEERING how and to what extent the interests of either the United Kingdom subsidiary or the parent Du Pont Company would be affected if Britain joined the Common Market, Mr. Carpenter emphasised that the company would then consider making other Du Pont products in Britain, such as plastics, textile fibres and possibly Delrin acetal resins. His colleague, Mr. M. H. Campbell, observed that the company's thinking and planning would be much simplified if the European Free Trade Association and the Common Market were one.

Except for the fact that they are not so free to strike camp and move elsewhere as their highly capitalised American comperes, British companies must be subject to the same influences. Are companies outside the Common Market likely soon to suffer a sharp contraction of their markets? The second question is, do we want American firms to establish subsidiaries in this country? The advantages to Britain are well known, and at present many benefits are offered to such companies. It is significant that Du Pont's other European factory—for making Orlon—is in Holland, where the tax structure is similar to our own.

In the words of a French visitor to the Maydown Works: "If Britain joins the Common Market, the French language will be to Europe in a hundred years what Welsh is in Britain today."

General Post Among the Government

What significance for the engineering industries have the long-awaited changes in the make-up of the Government?

The outstanding move is that of the former Chancellor of the Exchequer, Mr. Peter Thorneycroft, from the back benches to the position of Minister of Aviation. Mr. Thorneycroft left office because he believed that Government spending should be held at the level it had reached and not allowed to go on increasing.

This is just what Mr. Amory has come round to doing in the nationalised industries, and back comes Mr. Thorneycroft.

But with what effect on the aircraft groups? The big long-term question for both the airframe and the aero-engine groups is the supersonic airliner.

The last Minister of Aviation, Mr. Duncan Sandys, indicated that the Government would expect the airframe and aero engine group chosen to make some contribution towards the development costs. There are vague estimates of anything from £100 to £200 million to be heard, although the final bills could be very much greater.

Perhaps it will be Mr. Thorneycroft's view that the Government subsidy should be less and the industry's contrimution more.

One of the former Chancellor's colleagues in leaving office was Mr. Enoch Powell. As the new Minister of Health he now has his chance with his own department, and it will be interesting to see whether civil engineers and architects will be given theirs with the new hospitals.

Will the new Chancellor of the Exchequer, Mr. Selwyn Lloyd, follow his predecessor's technique of boom and brake. There are many industrialists who will readily explain to Mr. Lloyd just why wild swings between credit squeeze and money for all are the opposite of what is wanted for an orderly advance.

Perhaps Mr. Lloyd will prove to be a Minister who has read the Radcliffe Report for himself and is ready to put a more rational scheme into practice.

Brighter Prospects on the Road

The news that expenditure on new roads and major improvements will go up from £65 million to £76 million next year—and to £88 million in 1962-63—will bring joy to many civil engineering contractors and plant manufacturers, and hope to the several thousand holiday-bound motorists caught in traffic jams on their way to Cornwall, Blackpool and elsewhere.

There have been numerous complaints from contractors during the last twelve months or so that expensive road-making plant has had to lay idle, and rotting, for the want of work. Everything will be lovely indeed if the width of traffic lane on the new roads is the same as that for which the idle plant was made.

The most important part of the announcement, which was made by the Minister of Transport in answer to a question in the House, dealt with the classified roads, for which local authorities are responsible under a grants system. Over the next five years expenditure will be £150 million, more than double the current rate. Much of the increase is to be devoted to relieving urban congestion, a welcome recognition of where the major problem is now to be found. It is intended, said the Minister, to get road programme prepared three years ahead of work and to keep it there. Borough engineers and their staffs must be overjoyed at the prospect of more to show for their endeavours.

of Choosing which Airframe Group

The effect on the airframe group in the United Kingdom aircraft industry which does not receive the design contract for a supersonic aircraft will be far reaching.

If he does not alter the method of working suggested in a Parliamentary reply by his predecessor at the Ministry of Aviation, Mr. Thorneycroft will shortly select either the Hawker Siddeley Group or the British Aircraft Corporation to go forward into the detail design work on the airliner.

It is possible that British Aircraft will still be building numbers of the VC 10 and the Super VC 10 after de Havillands, now of the Hawker Siddeley team, have run their race with the Comets. Other and more subtle considerations apply to the official choice, and a substantial one must be that of money.

Financial Terms

Discussions are now under way between the Ministry and the four companies concerned, the other two are the aero-engine firms, Rolls-Royce and Bristol Siddeley Engines. And they are concerned to a large extent with the financial terms on which the work will be done. Not least with how much money the groups want from the Government. There is no reason why it should be the same for Hawker Siddeley as for British Aircraft. And the same applies to Rolls-Royce and Bristol Siddeley Engines.

Hawker Siddeley are in the excellent position that, apart from de Havillands, Blackburn and Folland in the group, they are still well diversified through a broad sweep of industrial and transport manufacture. This is a useful counter in the financial talks with the Ministry, affecting the reserves position within the group and the potential fund raising situation.

The British Aircraft Corporation is limited as an aircraft (and missiles) concern. It would be an enormous discouragement for the group not to be awarded the supersonic design contract. Since it has only the one purpose, even if it does not get the contract it will have to continue in the aircraft business to the top of its strength.

If the decision goes against Hawker Siddeley a quite different position arises. The disappointment will be no less. But all the potential—of engineers and of capacity—could be found other, not necessarily aerial, outlets.

The greatest care needs to be given to the choice, with the future of what competition there is in the British air craft industry at stake. For when the two airframe groups were formed the joke went round that SBAC (Society of British Aircraft Constructors) should now stand for Society of Both Aircraft Constructors.

It would be a serious business if SBAC came to stand for the Single British Aircraft Constructor.

What the Airlines Expect from the Makers

This year's Society of British Aircraft Constructors' show at Farnborough will perhaps be notable for three aircraft. They are the Armstrong-Whitworth Argosy, the Avro 748, the Handley Page Herald, and the Fairey Rotodyne.

Still needed is a general-purpose very-cheap-to-operate aircraft in succession to the honourable but now rather dated Dakota.

Armstrong Whitworth look as if they may have the answer with their Avro 748, which brings the cost per passenger mile down to a point where the very economy begins to generate further business. This is the sort of selling point that can carry an aircraft into the sales stratosphere.

There is also a wide market for a lighter shorter-range passenger aircraft, readily put to use as a flying conference room for businessmen who must spend a high proportion of their time between one visit and another. The Handley Page Herald is one answer.

And between cities, and for slightly longer flights than that phrase normally connotes, an aircraft that does not need runways miles long and yet is something more than a helicopter is awaited. The Rotodyne vertical take-off airliner is favourably placed in the race to meet this need and may have advanced a long way before Farnborough comes round again.

Any one, or all three, of these aircraft stands more than a chance of making just that appeal to the operators, and accountants not least among them, who run the world's airlines, and of going into very long production runs indeed.

and Communications through Satellites

America's National Aeronautics and Space administration (NASA) has sponsored a space communications research project, known as "Project Echo." The object of this is to put a 100 ft diameter balloon satellite into orbit and then bounce voice signals off it between points as far apart as the east and west coasts of America.

In commenting on this, Mr. F. R. Kappel, president of the American Telephone and Telegraph Company, said that research in space communications is aimed at creating thousands of high quality voice channels that will connect all parts of the globe.

Mr. Kappel went on to say, "We start with the idea of getting perhaps 500 to 1,000 (voice channels) out of a single system and hopefully, later on, a great many more than that. Moreover, if by using a number of satellites we can span one ocean, then by using the same satellites plus a few more, we can span others as well. We can create several systems interconnecting different points, instead of just one."

A system such as Mr. Kappel has suggested offers the only foreseeable hope for world-wide television.

Internally Ribbed Tube Made by Rolling

Precision tubes with internal ribs are now made. Heat exchangers are the obvious outlet, but could this tubing be exploited to save machining on other components?

IN AMERICA a longitudinal rib on the inside of a tube is called a fin; in the United Kingdom a similar fin on the inside of a similar tube is called a rib. The important fact emerging from this, however, is not what one calls the creature, but that it can be made at all. Two firms at least are interested in making tubes with internal ribs—Weldless Steel Tube Company in Birmingham, England, and Damascus Tube Company of Greenville, Pennsylvania, USA.

Damascus Tubes call their product Flo-Rol while Weldless call theirs Colduce. From the two names one can discern what the process is about: precision tubing with or without internal ribs is made by cold reducing a tube around a mandrel. If there are grooves around the cylindrical surface of the mandrel then ribs can be formed, and the limitation on the size of the ribs is determined mainly by whether the wall thickness and ductility of the original tube is sufficient to allow metal flow into the grooves. The deforming action derives from tools (of which one is shown in the cut-away drawing supplied by Damascus) which rotate relative to the tube surface and move radially inwards when the rollers pass over the humps. Hence the tube is subjected to an action similar to swaging. ICI comment that they could *roll* internal fins on Integron tubing with a grooved mandrel, as do Wolverine Tubes in the USA.

The obvious outlet for such tubing is for heat exchangers, and in fact the one large order for internally ribbed tubing supplied by Weldless has been for superheater tubing for the Trawsfynydd power station. This was a low carbon steel, but if similar tubes are required for higher temperatures, the company may have to turn to 0·5Mo-steel or 1Cr-0·5Mo-steel.

It is not easy putting ribs on to the inner surface of tubes; for a seamless product the only alternative at the moment is extrusion. Low Moor Fine Steels extrude internally finned tube, but the length is at present limited to about 10 ft. Stewarts and Lloyds make a welded product from rolled " multi-finned " strip.

One can imagine several uses for internally ribbed tubing, say as the starting stock for making gears, and several other ideas from Damascus are shown in the box. Capacity for making such material in this country is, unfortunately, limited, so it won't be much good trying to get sample lots of new profiles in a hurry. They would be made (at all) by Weldless in their factory at Kirby Muxloe, near Leicester, which was opened last year for making precision tubes for ball bearing manufacturers. (The process in use for cold reducing tubes for ball races is just the one used for internally ribbed tube). But this factory is working to capacity.

Damascus have produced exciting profiles by their process and the illustrations used in this article are derived entirely from what they have already achieved and what they think could be achieved. One of the benefits of cold reducing in this manner is the fine tolerances and surface finish: wall tolerances can be held to 0·0005 in and diameters to 0·002 in. Several duplex and triplex tubes have been made by the company and precision tubes have been satisfactorily made in Hastelloy, Zircaloy, tantalum and titanium. With a maximum length quoted by Damascus as 75 ft, and by Weldless as about 40 ft, the possibilities are immense.

WHAT DAMASCUS TUBES CAN ATTAIN. .

Tolerances

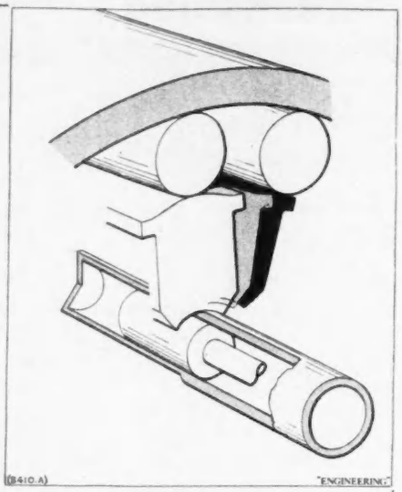
Around 0·0005 in on wall thickness
Around 0·002 in on overall diameter

In These Sizes

Lengths up to 75 ft
Outside diameters, ½ to 3 in
Wall thickness 0·016 in upwards depending on the OD

And In These Materials

Stainless Steel, all grades
Titanium and its alloys
Zirconium and its alloys
Tantalum
Many other metals



WHERE YOU COULD USE INTERNALLY RIBBED TUBING. . . .

Heat exchangers

Heat transfer rate is improved and external fins can easily be welded on

Fractional HP motor housings

Accurate, concentric housings with any number of symetrical or asymetrical ribs could be obtained by cutting from long lengths

Aircraft hydraulic tubing

Thin wall tubing can be supplied in ½ to 3 in sizes

Hydraulic couplings

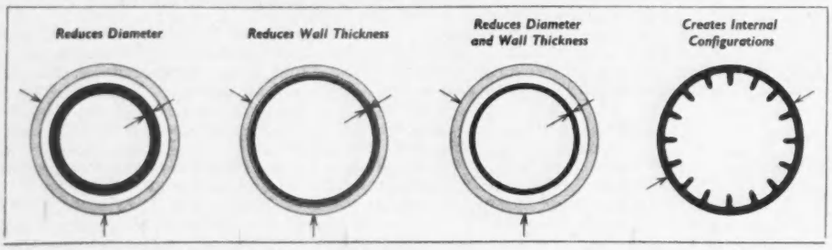
Good concentricity, diameter tolerances and smooth finish can reduce time spent on honing and lapping

Pump cylinders

Damascus Tubes finish Flo-Rol tubing to a finish of 5 micro-inches for this application

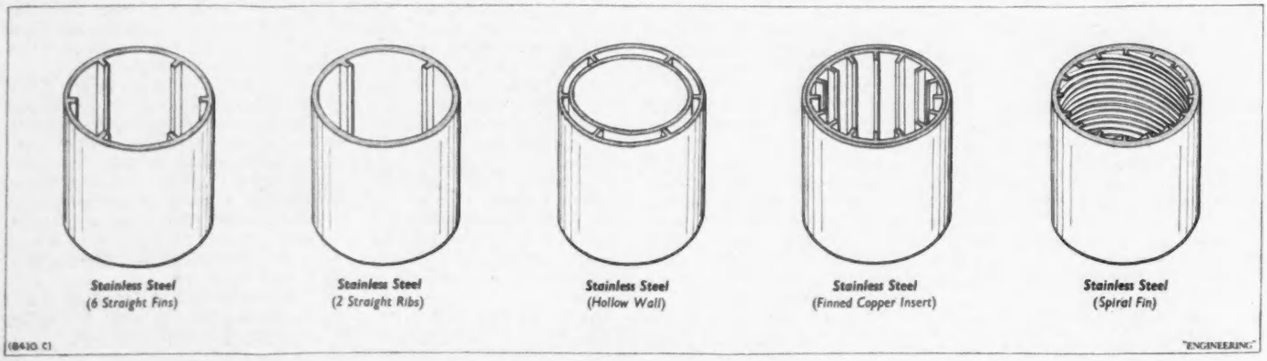
Gears

Internal teeth would need little machining with suitable profile



(*Left*) *What* can *be done.*

(*Below*) *What* has *been done.*



Sintered Wire Filter Elements

A new series of filter media made by Vokes under the name Poroloy CM or T, offers design engineers a combination of many distinct advantages and features which, it is claimed, are to be found in no other filter material. Generally manufactured in 18Cr–8Ni–stainless steel, it is also available in other alloys, such as nickel-chrome, Inconel, various forms of stainless steel and, indeed, in almost any metal which can be drawn into fine wire forms.

Filters are manufactured with inserts in the form of seamless porous tubes, flat sheets, pleated discs, pleated cylinders and many other forms made possible by the material's ductility and high-strength characteristics. Poroloy can readily be welded, silver soldered and cemented.

Owing to the material's sinstered construction, which securely bonds all wires at the point of contact, it is completely free from media migration and has outstanding fatigue resistance, which means that it can be used where there is likelihood of sudden pressure surges and conditions of severe vibration.

Filter inserts can be designed to withstand differential pressures of over 3,500 lb per sq. in without failure. Operating temperatures range from $-350°$ F to above $+500°$ F, according to the materials used and the construction of the filter. The nominal pore size ratings vary from 2 to 1,000 microns.

The field of application is extensive and includes the intricate, high-pressure hydraulic, servo and fuel systems applicable to aircraft, guided missiles and rockets, and such fluids as hydraulic fluids, acids, fuels, cryogenic fuels, nuclear fluids, gases, solvents, lubricating oils and caustic solutions.

Vokes Limited, Henley Park, Guildford, Surrey.

New Silicone Grease

A new silicone grease, M494, has been added to the rapidly growing range of ICI Nobel Division silicone products. The electrical qualities of M494, coupled with the silicone characteristic of intense water-repellency, make it an efficient sealing agent for electrical equipment, and as a general agent to protect surfaces against moisture.

M494 is claimed to have proved its worth in a variety of applications which include protection of insulations from corona discharge; as a sealing and potting grease in electronic equipment; lubricant for electric cable prior to its being drawn through conduits or harness; release agent in moulding and casting operations; packing grease for glands and for impregnating asbestos packings to prevent sticking of joints; glass stop-clock lubricant; lubricant for preventing sticking of screw threads, for example, with electric fittings located outdoors; and as vacuum sealing grease.

Imperial Chemical Industries Limited, Imperial Chemical House, Millbank, London, SW1.

Magnesium Carbonate Thermal Insulation

An improved type of magnesium carbonate insulating material is being made by the Chemical and Insulating Company Limited, a member of the Darlington Chemicals Group. This material, which will be called Supermag, is available in preformed sections and slabs for fitting to pipework and boilers, for use in industry where the prevention of heat loss is important.

The material is a mixture of magnesium carbonate trihydrate with asbestos in the proportions 85 to 15 per cent as are the traditional magnesia compounds, but a unique manufacturing process changes its form and bonds it with the asbestos at a critical temperature. Mr. F. R. Gibson, managing director of the manufacturers, speaking in London this week, said " Supermag is now in quantity production and is coming into general use. It is firmer, more easily handled, harder and stronger than orthodox magnesia products, and is also resistant to water." The Chemical and Insulating Company Limited is the only source of supply in the Eastern hemisphere. Both Supermag and ordinary magnesia insulation is made in three thicknesses (1 in, $1\frac{1}{2}$ in and 2 in) for 22 sizes of pipe, giving 66 variants in all. Many of these, as ready-packed sections, are held in stock.

Chemical and Insulating Company Limited, Darlington, Co. Durham.

"Design" Research into Corrosion

Experience has shown that the poor design of metal objects and structures can lead to serious damage through corrosion. Typical faults that lead to rusting are enclosed areas which form traps for condensed moisture, horizontal surfaces on which water can lie, and design details which cannot be reached for maintenance purposes.

The problem is clearly of practical importance and the corrosion committee of British Iron and Steel Research Association have therefore, decided to undertake an investigation. The scope of the research will be wide and will relate to structures and assemblies of all kinds. Moreover, the term " design " will be liberally interpreted, so as to include not only general layout and design proper, but also the choice of materials and of protective schemes. Structures will first be classified by type and environment; then examples of each type will be inspected from the point of view of corrosion design. Any undesirable features will be listed and practicable alternatives will be checked in consultation with engineering experts, and by experimental work, coupled where possible with service trials. It is hoped that, as a result, a code of recommendations will ultimately be published.

The investigation is of interest to architects, designers and engineers in many fields. Equally, their specialised knowledge and experience would help the investigators, who would welcome suggestions and comments on their proposals. Communications should be addressed to the technical secretary of the corrosion committee.

BISRA, 140 Battersea Park Road, London, SW11.

Composite Rigid/Flexible Pvc Sheet

To meet the need of the chemical plant and associated industries for a tough thermoplastic sheet of excellent chemical resistance and high-impact strength, Bakelite have developed a new grade of pvc sheet, known as Vybak DVR258.

This material is a rigid/flexible *composite* sheet and is particularly suitable for tank lining applications. The flexible portion gives added strength to the sheet and is more easily cemented to metal than rigid sheet. The rigid side, in its turn, has superior chemical resistance to the flexible portion.

Vybak DVR258 can be sawn and drilled in machines similar to those used in the woodworking and light-engineering industries, and is easily welded by the hot-gas welding technique. Due to its thermoplastic nature, this material is easily formed by heating to around its softening point and can then be cooled in contact with the desired contour. Further information can be obtained from the makers.

Bakelite Limited, 12-18 Grosvenor Gardens, London, SW1.

Synthetic Rubber in Rotterdam

A new synthetic rubber plant costing more than £10 million and initially capable of producing 60,000 tons a year, was opened in June last at the Shell Pernis Refinery, near Rotterdam.

The plant covers 25 acres, and is an important extension of Pernis's chemical industry, already the largest in the Netherlands. It will be able to supply all the synthetic rubber of the styrene/butadiene (SBR) type the Benelux countries need. Large quantities will also be exported by sea, river, rail and road.

Mr. L. Schepers, a managing director of the Royal Dutch/Shell group, said SBR was actually preferred nowadays in about one-third of all rubber applications. In another third, natural rubber still received preference, while the remaining third is divided between both forms of rubber.

The new Pernis rubber plant consists of three units: one for the manufacture of styrene, one for the production of butadiene, and a polymer plant where the two raw materials are combined to produce synthetic rubber. Styrene and butadiene are mainly derived from oil.

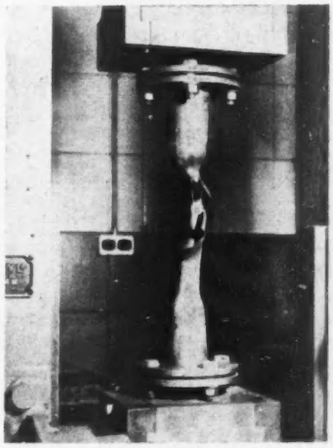
In March of this year, after intensive research, Shell announced new developments concerning the future production of polybutadiene and polyisoprene rubbers (the latter being already manufactured on a commercial scale by Shell in the USA) in the United Kingdom and in Holland. The Royal Dutch/Shell group companies are currently spending about £20 million a year on research of all kinds.

Shell International Chemical Company Limited, 1 Kingsway, London, WC2.

Flange Strengths on Plastic Tubes

Independent tests to prove the strength of Bulldog flanges for polyethylene pipes have been undertaken by the City of Birmingham Research Laboratories at the request of the manufacturers, Foster Brothers Limited.

These patented flanges eliminate the dangers inherent in the previous method of welding



flanges on to polyethylene pipes, particularly that of undue heat on the materials, leading to oxidation and embrittlement.

By forming the flange on the end of the pipe out of a double thickness of the pipe wall (using a hot gas or vapour under strictly controlled conditions), the Foster method ensures a completely corrosion-proof joint because there are no metal parts—the metal backing flanges are kept well clear—in contact with the liquids within the pipe.

The laboratories' test involved a short length of Deltathene high tensile polyethylene pipe (measuring $3\frac{1}{2}$ in outside diameter by $\frac{1}{4}$ in long), fitted at both ends with Bulldog flanges and secured to the test machine by mild steel backing flanges. The result showed that the bond of the double-thickness pipe-wall flange and backing flanges, as is to be expected, make it far stronger than the pipe itself.

Foster Brothers Limited, Lea Brook Works, Wednesbury, Staffordshire.

Plain Words

By Capricorn

ONE of the attractive features of our too, too delightful Standard of Living is the ease with which we can travel far away on holiday. Our grandfathers thought they were lucky, with their night trains to Scotland or their Continental expresses for the Grand Tour, but actually they had no conception. My dear, in a twinkling we can go as far as they could go in an age.

Taking advantage of this amenity, I once travelled to the French Riviera. About eight hundred miles. I basked in the sun. I did a little leisurely motoring. I went up on to the Grand Corniche and gazed in idle surmise on the Mediterranean while sipping a glass of wine. The peace of the place was disturbed—not at all rudely—by a party of film-makers. They came along with their camera mounted on a special motor-car chassis, filming the road rearwards as they motored. I chatted with one of them while he stopped in the village to control the random people who might get in the picture. He seemed to have an idyllic job. He lived and had his headquarters in Paris, and he was " working " on the Riviera with the stars. I was curious to know where and how he could possibly take his holiday. " I go fishing," he said—" in Wales."

The perversity of human nature! There was a French film-maker, prepared to travel a considerable distance to reach the land which to me, in terms of holidays, meant a mere thirty-mile journey as a child with bucket and spade. As a man, I too was motoring hundreds of miles at enormous expense—in the opposite direction and to reach the land where this Frenchman worked.

It is laughable, but not surprising, that we should change places like fielders at the end of a cricket over. It is part of the illusion ritual we call holiday. It is refreshing to get away from people of our own nationality. The strange, half-understood sounds of a foreign language have a beckoning, seductive appeal which makes the long journey worth while.

The value we set on such escapism is best appreciated by noting our reaction when, as we lie on the beach, we espy an all-too-obviously English family bearing down on us, and as they elect, by some herd instinct, to squat within sand-throw, the voice of the harassed mother transports us back with sickening reality to the industrial counties of England. So much for the romantic journey, and the enormous expense. So much for the ease with which we can travel far away on holiday.

I knew there was a catch somewhere in our Standard of Living creed. A high S. of L. is a fine thing so long as there are not too many others enjoying it. When everyone seems to be partaking, it's time to get away from it all. It's time to go on a very long journey.

Letters to the Editor

Bonus Schemes Need Work Study

SIR, In his letter of 1 July (ENGNG., 15 July '60, p. 76) Mr. W. G. F. Thorley suggests that the type of bonus scheme which I described (" Bonus Schemes are Not What They Seem," 17 June '60, p. 822) will " never work successfully so as to constitute a fair deal for both management and men . . . " That is exactly my view.

I described a system which, with individual variations, is in use in a large number of factories, and I was concerned to point out the defects of such a system. Mr. Thorley and I are apparently agreed that these defects exist. I also quite agree with Mr. Thorley that perhaps the only way in which a bonus scheme can be made to work successfully is for it to be based upon the use of work study. But the degree to which work study is actually used in this country is small compared to its potential use. A large number of firms still rely upon the traditional rate fixer, and it is conjectural to what extent a more detailed approach to the subject will ever be economically possible and actually adopted by a large number of firms.

I sincerely hope that such an approach will be widely adopted. But in the meantime the disadvantages attaching to a bonus scheme based upon the rate fixer are bound to be present.

I am, Yours faithfully,
R. J. B. STEIN.

1 Temple Gardens,
Temple,
London, EC4.

27 July, 1960.

Mechanisation of the Post

SIR, In connection with your article on " Machine Design for Postal Mechanisation " (ENGNG., 22 July '60, p. 130), we would like to point out that the credit for the machines shown in Figs. 2 and 3, given to Elliott's, should belong to the Post Office. The photographs are of the prototypes built by them which have been working for some years at the Southampton Post Office.

The production machines which we are making for post offices in this country and abroad are very similar, but incorporate a number of improvements requested by the GPO as a result of their operational experience. The pattern of development in this respect is very similar to that of a number of other units forming part of the postal modernisation programme.

Yours faithfully,
M. G. SMITH,
Manager.

Mechanical Automation Division,
Elliott Brothers (London) Limited,
Century Works,
London, SE13.

29 July, 1960.

Grand Contour Canal

SIR, Mr. J. F. Pownall's restatement of his water grid proposals (ENGNG., 15 July '60, p. 82) could not have been more timely.

Few people appreciate the speed with which irrigation is catching on among farmers. They are beginning to realise that with irrigation they can be almost independent of the weather. Yields of many crops can be increased substantially.

In a recent article in *Agriculture*, the journal of the Ministry of Agriculture, a writer showed, for example, that in five of the nine years, 1951 to 1959, potato yield increases of between 50 and 100 per cent were obtained as a result of irrigation in different parts of the country. Translated into financial terms this represents an average increase in income in every year of £22 per acre.

Irrigation affects grassland farmers in a different way. Since they do not have to devote extra acreage to grass for summer use as an insurance against drought, the acreage thus saved can be used to grow other crops.

If the popularity of irrigation increases at the present rate, water supplies will soon be more seriously affected than ever before. The recent hydrological survey of the River Great Ouse Basin estimates that future demand for irrigation water in a dry year, if only one-tenth of the crops in the area suitable for irrigation are in fact treated, will almost equal the total future demands for water by all other users. This is a revolutionary concept of water need and it seems that only exceptional measures will be able to meet the situation.

Yours faithfully,
ARNOLD BARFIELD.

Farm Intelligence Limited,
42 Parliament Street,
London, SW1.

26 July, 1960.

Bearing Wear

SIR, An article entitled " Bearing Wear in Corrosive Atmospheres," by Mr. H. H. Heath, of the Atomic Power Division, English Electric Company Limited, was published in your journal recently (ENGNG., 17 June '60, p. 841).

Much of the content of this article should not have been under this heading, since it was concerned mainly with the description of general mechanical engineering laboratory facilities, not associated with bearing wear.* Such generalities are completely unwarranted in such an article, which, to have true import, must be specific within the bounds of the heading.

The author surpasses himself in the confusion already engendered, when, after having stated an empirical life/load relationship that he had derived for unlubricated ball bearings, he attempts to make an analogy to that for lubricated ball bearings. This latter function is stated by Mr. Heath as:

$(\text{Life})^3$ is proportional to (Load).

Unfortunately, such a favourable state of affairs does not exist in engineering. It appears that Dr. Palmgren's endurance formula has been misunderstood, which, when reduced to a simple proportionality, takes the form:

(Life) is inversely proportional to $(\text{load})^3$ . . . . . See *Rolling Bearings* by G. K. Allen.

Furthermore, the life relationships in the article have been founded upon an exceedingly small number of observations. A considerable scatter in results usually occurs from the form of detection of failure described, and Dr. Palmgren has specified that a minimum of 30 observations is necessary to determine any particular life characteristic.

It is also extremely difficult to determine from a few results whether a life characteristic is an exponential or a power function, due to the high range of scatter that ball bearing " lives " are known to fall within. Hence, a suggestion should be put to the author to make many more tests before " rushing-to-press " with a new characteristic life form.

Yours sincerely,
A. C. WREN.

Newsham,
Richmond,
Yorkshire.

29 July, 1960.

* *Editor's Note:* Less than one-sixth of the text is concerned with the general facilities of the laboratory.

Events in Advance

Quality and Endurance of Materials and Structures

MUCH attention is being given at the present time to the endurance qualities of materials and structures, especially in the electrical industry, and arrangements are now in being to hold a conference on Non-Destructive Testing in Electrical Engineering at the Institution of Electrical Engineers from 8 to 10 November, 1961.

The event is being organised by the Measurement and Control Section of the Institution, in association with the British National Committee on Non-Destructive Testing, and the general theme for the conference will be "How Best May the Electrical Engineer Test the Quality and Endurance of His Materials and Structures." It is intended that the meeting shall concentrate its attention on papers which deal with electrical methods of testing. Papers on the better-known methods of non-destructive examination, as used for the detection of defects in materials and structures employed in civil and mechanical engineering, will, in general, be excluded.

On the other hand, the organising committee will be pleased to consider contributions dealing with the testing of such substances as plastics, rubbers, laminates, glasses, ceramics, enamels, anodic coatings, papers, plastics foils, metallic foils, insulating liquids, and magnetic materials; the detection of impurities and inclusions in insulation; the detection of defects in insulators and bushings; and the detection of concealed internal features, such as cable cores and potted components.

A welcome will also be accorded to papers discussing proof and maintenance tests on insulation, including the measurement of discharge inception stress; the measurement of loss angle and conduction; over-voltage tests; electrical and mechanical tests on cables, cable sheaths and cable accessories, as well as papers on the testing of interfacial contacts and joints (electrical and mechanical); and on the detection and damping of vibration. The testing of thin insulating coatings on metals and the detection and measurement of leaks in electrical equipment (gases, liquids and micro-organisms) are other subjects upon which the committee hope to receive papers.

Prospective authors should submit synopses of their proposed contributions as soon as possible to the secretary, the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2 (Telephone: COVent Garden 1871). The full contributions should not exceed a maximum of 8,500 words in length, but the submission of short papers of 500 to 1,000 words will also be appreciated.

World Power Conference Goes to Melbourne in 1962

The sixth plenary meeting of the World Power Conference is scheduled to be held in Melbourne, from 20 to 26 October, 1962, and the technical programme for this event has now been issued by the Australian National Committee, 45 Little Lonsdale Street, Melbourne C1, Victoria, Australia.

The committee have taken "The Changing Pattern of Power" as the theme for the meeting and hope, in doing so, to emphasise the many changes that have taken place over the entire field of power production, transportation and utilisation, since the fifth plenary meeting of the Conference took place.

They expect to achieve this end by providing for the consideration and discussion of forecasts of expected future developments as well as reports of past progress. It is appreciated, however, that the speed of development will vary greatly throughout the many sections of the world's power industries and, while desiring to stress the rapid changes that are occurring, the committee do not wish to discourage reports or papers along other lines. The committee recommend to prospective authors that, in preparing their papers, they should keep the central theme of the meeting in mind and introduce references to it at appropriate places in their contributions.

In all, there will be five divisions to the meeting. The first division will provide, under subdivision I1, for discussion on the World Power Conference's *Survey of Energy Resources* and on the United Nations' "J" series of publications. Under subdivision I2, there will be provision for the discussion of the various national surveys prepared by each national committee dealing with developments in the exploitation and use of all primary sources of energy.

The remaining four divisions will cover papers dealing, respectively, with the production and amelioration of primary sources of energy; the transformation of primary to secondary energy and the transportation of energy; the utilisation of primary and secondary energy, with subdivisions determined on the basis of broad classes of user; and the economic evaluation of alternative sources of energy.

For the guidance of authors, it is pointed out that, while these divisions are intended as a guide to the scope of papers, their demarcation lines should not be interpreted so rigidly as to exclude matter relevant to another division. Papers which deal with comparisons or the interrelationship between the various forms and uses of energy should be aimed at the central theme as far as possible.

Papers containing historical survey material will only be considered appropriate if they are used to illustrate changing habits or practices, and thereby aid planning for the future.

It may be mentioned that there will be a sectional meeting of the Conference in Switzerland in 1964. Persons and organisations in Britain may obtain additional information from the secretary, British National Committee, World Power Conference, 201-202 Grand Buildings, Trafalgar Square, London, WC2, or by telephoning WHItehall 3966.

Meetings and Papers

Association of Supervising Electrical Engineers

LONDON

"Floor Heating" by C. J. Wheeler. South West London Branch. Prince of Wales Hotel, SW19. Thurs., 11 Aug., 7.45 p.m.

Institute of Metals

LONDON

"The Physical Nature of Plastic Flow," by Dr. J. J. Gilman. Tues., 16 Aug., 6.30 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (LANgham 5927)
Institute of Metals, 17 Belgrave Square, London, SW1. (BELgravia 3291)

Exhibitions and Conferences

Gift Show, 41st Western.—Sun., 7 Aug., to Wed., 10 Aug., in San Francisco. Organised by Western Exhibitors Inc., Space 223A, 1355 Market Street, San Francisco 3, California, USA.

Royal National Agricultural and Industrial Show.—Thurs., 11 Aug., to Sat., 20 Aug., at Bowen Park, Brisbane. Organised by the Royal Agricultural and Industrial Association of Queensland, Primary Buildings, 99 Creek Street, Brisbane, Queensland, Australia.

Damascus International Trade Fair.—Mon., 15 Aug., to Sat., 10 Sept., in Damascus. Apply to the Director General de la Foire Internationale de Damas, 187 Boulevard Bagdad, Damascus, Syria.

Pacific National Exhibition.—Sat., 20 Aug., to Mon., 5 Sept., at the Exhibition Park, Vancouver. Apply to the organisers, Pacific National Exhibition, Exhibition Park, Vancouver 6, British Columbia, Canada.

Izmir International Trade Fair, 30th.—Sat., 20 Aug., to Tues., 20 Sept., at Izmir, Turkey. Apply to the secretary, The British Chamber of Commerce of Turkey, 246 Necati Bey Caddesi, 4-5 Buldanloglu Han, P.O. Box 190, Galata-Istanbul, Turkey.

Health Exhibition, International.—Sat., 20 Aug., to Sat., 5 Nov., in Rome. Apply to Mostra Internazionale della Sanita Delgazione per le Partecipazioni Industriali, 5 Via Olmello, Milan, Italy.

Giftware Show.—Sun., 21 Aug., to Wed., 24 Aug., at the New National Guard Armory, Olympic and New Washington Hotels, and Terminal Sales Building, Seattle. Organised by Western Exhibitors Inc., Space 223A, 1355 Market Street, San Francisco 3, California, USA.

Fancy Food and Confection Show, National.—Sun., 21 Aug., to Wed., 24 Aug., at Hotel Astor, New York. Organised by the Charles Snitow Organization Inc., 331 Madison Avenue, New York 17.

Western Electric Show and Convention (WESCON).—Tues., 23 Aug., to Fri., 26 Aug., at the Memorial Sports Arena, Los Angeles. Offices: 1434 S. La Cienega Boulevard, Los Angeles 35, California, USA.

Technics and Technical Achievements, Fourth International Fair of.—Tues., 23 Aug., to Fri., 2 Sept., in Belgrade. Apply to Beogradski Sajam, P.O. Box 408, Belgrade, Bulgaria.

Canadian National Exhibition.—Wed., 24 Aug., to Sat., 10 Sept., at the Exhibition Grounds, Toronto. Agent in the United Kingdom: Canadian National Exhibition Representative, British Columbia House, 3 Lower Regent Street, London, SW1. Tel. WHItehall 2794.

Norwegian Fisheries Fair.—Thurs., 25 Aug., to Sun., 11 Sept., at Bergen. Apply to the secretary-general, Norges Varemesse, 2 Tollbudgt, P.O. Box 784, Oslo, Norway.

Gift Show, Fall.—Sun., 28 Aug., to Wed., 31 Aug., at Radisson and Dyckmann Hotels, Minneapolis, Minnesota, USA. Organised by Helen Brett Enterprises Inc., 6 East Monroe Street, Chicago 3, Illinois, USA.

Frankfurt International Autumn Fair.—Sun., 28 Aug., to Thurs., 1 Sept., in Frankfurt. Agents in the United Kingdom: Lep Transport Ltd., Sunlight Wharf, Upper Thames Street, London, EC4. Tel. CENtral 5050.

Nuclear Structure, International Conference on.—Mon., 29 Aug., to Sat., 3 Sept., at Kingston, Ontario. Further details obtainable from Mr. R. L. Graham, Atomic Energy of Canada Ltd., Chalk River, Ontario, Canada.

Radio, Television and Electronic Equipment, International Exhibition of (FIRATO).—Tues., 30 Aug., to Tues., 6 Sept., at Amsterdam, Holland. In the United Kingdom, apply to Mr. W. Friedhoff, 10 Gloucester Place, London, W1. Tel. WELbeck 9971.

British Association Meeting.—Wed., 31 Aug., to Wed., 7 Sept., at Cardiff. Apply to the Secretary, British Association for the Advancement of Science, 18 Adam Street, Adelphi, London, WC2. Tel. TRAfalgar 5733.

European Fair, 35th.—Sat., 3 Sept., to Sun., 18 Sept., in Strasbourg. Apply to the Foire de Strasbourg, 9 Rue Brulee, Strasbourg.

Zagreb International Autumn Fair.—Sat., 3 Sept., to Sun., 25 Sept., at Zagreb. In the United Kingdom, applications should be made to Auger and Turner Group Ltd., 37-38 Margaret Street, Cavendish Square, London, W1. Tel. HYDe Park 7282.

Vienna International Autumn Fair.—Sun., 4 Sept., to Sun., 11 Sept., in Vienna, Austria. Apply, in the United Kingdom, to the Office of the Austrian Foreign Trade Representative, 1 Hyde Park Gate, South Kensington, London, SW7. Tel KNIghtsbridge 6938.

Levant Fair, 24th International.—Sun., 4 Sept., to Mon., 19 Sept., in Bari. Agent in the United Kingdom: Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Salonika Trade Fair, 25th International.—Sun., 4 Sept., to Sun., 25 Sept., in Thessalonika. Apply to Fair Committee Office, Thessalonika.

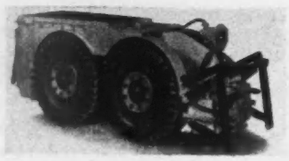
Production Engineering Show.—Tues., 6 Sept., to Fri., 16 Sept., at the Navy Pier, Chicago. Organisers: Clapp and Poliak Inc., 341 Madison Avenue, New York 17, USA.

Home Furnishing Show, 11th National.—Wed., 7 Sept., to Sun., 18 Sept., at the Coliseum, New York. Organised by the National Home Furnishings Show Inc., 134 Lexington Avenue, New York 16, USA.

Rheology of Polymers, Meeting on.—Thurs., 8 Sept., to Sat., 10 Sept., at Swansea. Organised by the British Society of Rheology. Further information obtainable from Dr. M. F. Culpin, 8 The Broadway, Pontypool, South Wales.

DIESEL MINE-TRACTOR

Flame Proofed



THE MT25 is a diesel hydraulic tractor designed for use in mines; it is fully flameproof.

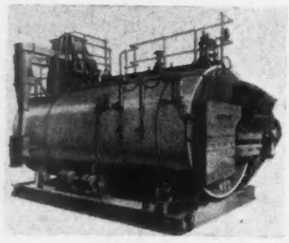
Power is supplied by the Perkins "Three 152" engine derated to give 25 b.h.p. at 1,650 r.p.m. A hydraulic starter is fitted and the drive is through a torque converter to an epicyclic forward and reverse gearbox, then through reduction and transfer gearing, and multiplate clutches to worm drives incorporated in the wheels, all four being driven. The design has allowed the width to be kept down to 3 ft overall. The length over the drawgear is 8 ft 11¼ in and the height is 3 ft 5 in.

The tractor is fitted with slew steering, giving it great manoeuverability and precision of control, and allowing it to operate alongside conveyors without damaging either them or the pit arches. The turning radius of 5 ft 6 in allows acute corners to be negotiated. Steering of this type eliminates the need for a differential lock. The carrying capacity on top of the tractor is 27,000 lb and on the carry plate 4,000 lb. Drawbar pull at starting is 4,200 lb falling to 2,900 lb at 2 m.p.h., and 1,700 lb at 4·0 m.p.h. A maximum gradient of 1 in 3 can be climbed at 1·3 m.p.h. with a superimposed load of 4,500 lb. In working order the tractor weighs 5,500 lb.

Control is by a throttle, a forward/reverse selector and two levers, each of which operates the brakes on one pair of wheels. The controls are arranged for driving in both directions of travel, the driver always facing the front. Maintenance has been reduced to a minimum: apart from the engine, lubrication is only necessary at 12-month intervals. The linkage will take an angledozer, a low-lift shovel of 2 tons capacity, fork lift, crane, and trailer couplings. *Hunslet Engine Company Limited, Jack Lane, Leeds 10.*

PACKAGED BOILER

Coal Fired



THE CoalPak is a packaged boiler for coal firing which is self-contained and compact.

The design follows that of the Paxman treble-pass Ultranomic with all-welded construction and full size manholes for access and cleaning. It is mounted on its own base and can be seated as a complete unit with a minimum of foundations and installation work. The only connections needed are those for the main services.

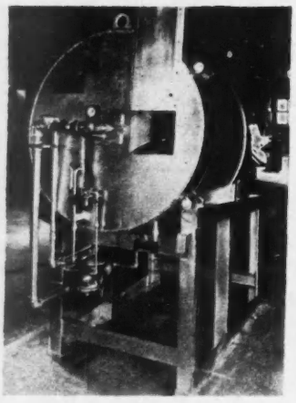
There are eight sizes in the range with overall lengths from 17 ft 6 in to 21 ft 3 in and outputs from 2,000 to 8,500 lb of steam per hour from and at a temperature of 212° F.

Mechanical firing is by a Hodgkinson low ram coking stoker, which with the fan is modulated according to steam demands. At maximum loads the stoker is running continuously, but for partial loads an automatic turn down range is provided giving progressively shorter periods of firing as the demand is lowered. Automatic coal feeding to the stoker hopper can be added and automatically regulated if desired.

The boiler is lagged and provided with platforms for access to the major operational points. Adequate safety controls are also provided; in the event of low water the fuel and air supplies are automatically cut-off from the boiler and the plant is closed down. To meet the requirements of the Clean Air Act an efficient dust collector is combined with the induced draught fan; it is of the cyclone type and discharges into a hopper at the rear of the boiler. *Davey Paxman and Company Limited, Standard Ironworks, Colchester.*

ROTARY FURNACE

Gas Fired



NOW available in this country is a gas fired furnace designed by the National Furnace Corporation.

The furnace is of the rotary type and was designed primarily for heating stainless steel rods prior to rolling. The body is a welded steel cylinder with a 7½ in layer of refractory, standing on an angle iron frame. A spider inside the chamber carries 12 cups, each 4½ in inside diameter and 10 in long on a pitch circle of 25 in diameter. The spider is mounted on a shaft which protrudes through the back of the furnace chamber to the driving mechanism. Power is supplied by a ¼ h.p. motor and the shaft is indexed into 12 positions by an air cylinder.

The flame from the centrally placed gas burner plays on a cone set at the centre of the spider, the angle being designed to give optimum heat circulation in the furnace.

Working temperatures in the range of 1,400° F can be attained in about 2 hours from cold. The operator loads the cup through the hatch and then presses a knee switch to index the spider one position. Loading the 12 cups takes approximately 2 hours so that the contents of the first will be ready for removal by the time the last is filled. *Dowson and Mason Limited, Alma Works, Levenshulme, Manchester 19.*

FREQUENCY STANDARD

Up to 175 Megacycles

A PORTABLE instrument has been introduced for checking frequencies in the range from 7·5 to 175 Mc/s.

Basically the instrument consists of an oscillator which can be switched to operate with any one of up to 12 crystals; thermostatically controlled plug-in ovens (up to 6, each capable of holding two crystals); up to 3 multiplier units; a wide band detector; and rectifying circuits for operation on a.c. supplies of 100 to 130 V and 190 to 240V, 40 to 60 cycles.

A central 12-position control switches the desired crystal into an aperiodic Colpitts oscillator circuit. Trimmers allow slight "pulling" of each crystal frequency. Six lamps show when the ovens are on and the temperature is held at 80° C. Three types of multiplier are available, each operating over part of the band. With the × 18 unit the highest frequency obtainable is 175 Mc/s. At constant ambient temperature and after warming up the variation in crystal frequency and corresponding multiples is claimed to be not greater than 3 parts per million.

The voltage output available into a load of 400 ohms is greater than 2V in the × 1 range to greater than 1mV on the × 18 range. The amplitude of the input signal should not be greater than 100 mV.

The signal and the crystal frequency are fed to the wide band detector and the zero beat is detected by headphones. Primary taps on the power transformer give the range from 100 to 240 V in 10 steps. The instrument weighs 16 lb. *Wayne Kerr Laboratories Limited, Sycamore Grove, New Malden, Surrey.*

GEAR HONER

Up to 12 in Pitch Diameter

NOW to be made in this country is the new Red Ring gear honer model GHD.

The machine has a capacity for gears up to 12 in pitch diameter when hand loaded and up to 4 in p.d. when automatic loading is used. It has a stroke of 5 in and the hone diameter is 10 in.

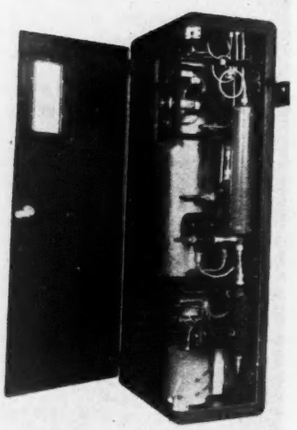
The same basic operating cycle is used as in earlier models, that is to say the abrasive impregnated gear-shaped honing tool is meshed with the work gear in a crossed axes relationship. During the honing cycle the direction of rotation is reversed and there is a recriprocating motion between the honing tool and the work gear in a path parallel to the axis of the gear.

Four methods of honing are possible. First, honing with backlash in conjunction with a locked honing head. Second, with zero backlash with pressure control in conjunction with the honing lock. Third, constant pressure operation with an automatic mechanical wedge-type back-up eliminator. Fourth, constant pressure operation with overload relief provided by an adjustable leaf spring back-up protector. A clutch in the hone drive prevents damage due to overloads.

There are three models; the standard, which has hand loading with automatic cycling; the fully automatic with magazine loading; and the fully hand operated. Floor space required is 47 in by 42 in and the machine itself stands 57 in high. *Precision Gear Machines and Tools Limited, Bodmin Road, Wyken, Coventry.*

HYDROGEN PURIFIER

Catalytic Action



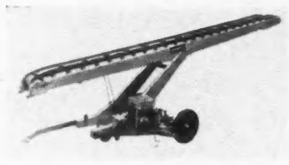
THE Deoxo Puridryer has been developed to facilitate the production of pure hydrogen for commercial uses.

The unit is self-contained and will purify commercial grade hydrogen to give a gas with an oxygen content of less than 1 part per million. By using a Linde molecular sieve as the drying agent, a dew point of −100° F can be achieved, which enables the gas to be fed directly to the furnace.

The standard unit has a throughput of 100 cu. ft per hour with a maximum operating pressure of 5 lb per sq. in. The pressure drop is approximately 1 lb per sq. in. Re-activation of the drying unit is automatic and takes five hours. The platinum metals catalyst used to remove oxygen requires no reactivation and unless poisoned by sulphur or other compounds should last indefinitely. The Puridryer may also be used with other gases such as nitrogen, argon, neon and saturated hydrocarbons providing enough hydrogen is present to react with the oxygen. Overall dimensions are 32½ in high by 13½ in wide and 8⅝ in deep. *Engelhard Industries Limited, 52 High Holborn, London, WC1.*

BELT CONVEYOR

Portable Unit



A PORTABLE belt conveyor for most general work is now on the market. Known as the Standard it has a maximum capacity for handling material up to a rate of 110 tons per hour at a speed of 220 ft per minute. The machine has been fitted with hydraulically controlled elevating arms so that with simple adjustment of the boom angle there is an infinite range of boom positions including a dip below ground level. A reversing gear incorporated allows the belt to run in both directions.

The illustration shows the conveyor fitted with belting having corrugated sides and made by the Dunlop Rubber Company. The belt is 16 in wide and the sides are 2 in high; it is also fitted with 1½ in cross bars set to a pitch of 20 in. Other types of belt can be supplied but this type is suitable for handling powder, granulated materials, bulk grain, sand, coal, coke, bricks, stone, clay, concrete, bales or cases.

Power to drive the conveyor is supplied by a 320 c.c. petrol engine, the drive from which is totally enclosed in the elevating arms. With the boom horizontal, the overall height of the unit can be varied from 2 ft 8 in to 8 ft 7 in. When one end of the boom is on the ground the maximum angle of elevation is 45°.

The Standard has a weight of 31 cwt all up, so it can be towed behind any conventional vehicle. The overall width of 6 ft 4 in allows it to negotiate most routes. There are two towing arms that can be folded back while the machine is running as a conveyor. In addition to the basic machine, a hopper can be attached for loading loose materials and the hopper capacity can be increased by the addition of extension pieces. In the illustration one of the towing arms is folded back. A smaller model, the Cadet, has a capacity of 75 tons per hour. *Numec Limited, Whittington, Chesterfield.*

THICKNESS GAUGE

Foils or Coatings

THE Elcotector Mark II is a portable instrument for non-destructive measurements, particularly of the thickness of foils or of metallic or non-metallic coatings.

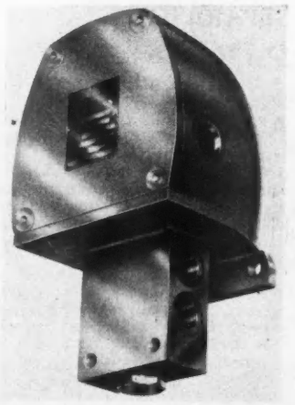
The standard instrument is battery operated and works on the change of inductance due to the presence of a metal surface. Variations in hardness and metal structure can also be detected. The coil is situated at the head of the probe which is presented to the surface under test. There are two forms of hand probe, one pencil shaped and the other angled for internal use.

Transistors are used throughout the instrument and printed circuits employed where possible. This results in a reduction in weight and bulk as well as in longer battery life. The black laminated plastic case measures approximately 8 in by 6 in by 4 in and is complete with leather carrying case and shoulder strap. With batteries, lead and probe, the weight is 7 lb 13 oz, the case adding another 4 lb approximately. Battery life is about 200 hours when using the instrument 6 hours a day.

The moving coil meter can be tilted for easy viewing and controls include a 10 turn potentiometer for adjustment and a sensitivity control. There are alternative models for wall mounting or for permanent installations as, for example, continuous strip measurement for which special probes are also available. *East Lancashire Chemical Company Limited, Fairfield, Manchester.*

HYDRAULIC VALVES

Solenoid Operated



A NEW range of solenoid operated hydraulic valves has been introduced for high pressure systems.

The range includes models for a.c. or d.c. operation with fluid flow rates up to 4 gallons per minute at pressures of 3,000 lb per sq. in. Valves can be provided for normally open or normally closed conditions as desired. Two, three or four ports can be incorporated and the solenoid coils can be selected for a wide range of operating voltages.

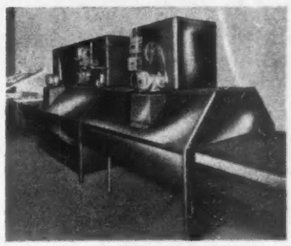
The model illustrated is a normally closed valve for operation on 240 or 415 V, 50 cycles. When energised the continuously rated solenoid thrusts a balanced poppet valve off its seat and permits fluid to flow from the lower ports to the upper at a maximum rate of 4 gallons per min at 3,000 lb per sq. in.

It is claimed that the poppet valve allows high pressure operation with the minimum current consumption and that the straight-through ports facilitate installation, and eliminate the need for T junctions in the hydraulic circuit. At 240 V the operating current is 2·5 A and the hold current 0·53 A.

Under normal conditions the permissible operating frequency is four per minute; more frequent operation is possible if micronic filtration is used for the oil. *Smiths Jacking Systems, Witney, Oxfordshire.*

PRINT DRIER

Any Size Sheet



SHORTLY to be manufactured in this country is the Advance Auto-Set drier for all types of print.

The basic machine consists of a drying section with a moving belt to carry the paper. To this can be added a cooling unit, a humidifying unit and extension drying units to give the required size for any application. The illustration shows a drier and a cooler.

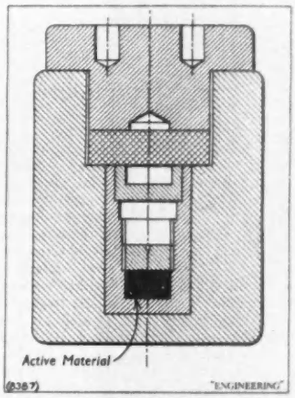
The printed sheets are carried from the frame on a conveyor which, in the latest model, consists of a series of webbing straps and not the metal net shown. The conveyor is driven by a separate motor at speeds which are variable to give times of passing through the drier from 9 to 33 seconds. This allows the right speed to be chosen for the ink being used.

In the standard model heat is supplied by a gas burner, the flame of which is enclosed in a separate cylinder so that no inflammable vapours can enter the flame zone. Air is blown round the cylinder to be heated and then passes through a diffuser plate to spread uniformly over the surface of the work. Inks that take 20 minutes to dry in air can be fully dried in the machine in 20 seconds at a temperature of 175° F. Provision is made for some recirculation of the heated air for economy.

Temperature control is fully automatic and the flame cannot be lit until the circulating fan is running. Sheets from 1 in to 86 in wide and any length can be dried. There are four sizes of machine, with maximum widths of 36 in, 48 in, 60 in and 86 in. Sheets from plywood to poster paper can be handled. *Gordon and Gotch Limited, 75-79 Farringdon Street, London, EC4.*

COBALT SOURCE

Small Sizes



NOW available in this country are the cobalt 60 sources that have been developed by Atomic Energy of Canada.

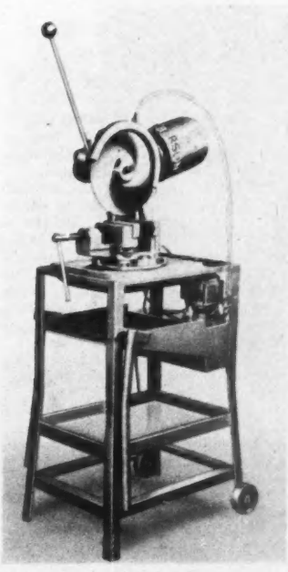
These sources have the extremely high specific activity of 100 curies per gram and are made from nickel plated cylindrical pellets of cobalt measuring 1 mm by 1 mm which are double sealed in welded stainless steel capsules. One form is shown in the illustration.

The main advantage of high specific activity is that the sources have small physical dimensions for their output. This enables sharper radiographs to be made or shorter film distances to be used reducing exposure times. There is also a lower degree of wasteful self absorption within the source.

A wide range is now available and dimensions are from 1 mm by 1 mm for strengths of 700 mc, and to 4 mm by 4 mm for strengths up to 20 c. The actual size of the one shown is 1·17 in high by 0·840 in across the corners of the hexagon. It is suitable for sources up to 0·266 gm. The outer container body is made of aluminium and the capsule itself is of stainless steel. Larger sizes with strengths up to 2,000 c have sources measuring 1·52 cm by 2·5 cm; the quoted figures for strength allow for self absorption within the source and are therefore the effective working values. *Watson and Sons (Electro Medical) Limited, East Lane, North Wembley, Middlesex.*

CIRCULAR METAL SAW

Swivel Head



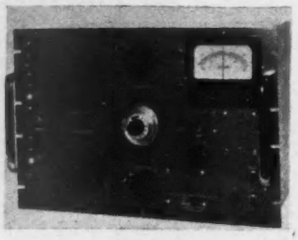
THE Barson-Rotor is a circular metal cutting saw that is fitted with a swivelling head.

The machine can be mounted on a stand as shown and supplied with a coolant system if required. The capacity is for tube up to 3½ in outside diameter and for solid bar up to 2⅜ in. Sections from 3½ by 3½ to 1½ by 6 in can be handled. The blade is 11 in diameter.

The cutting head with the motor swings to 45° in either direction and there is a graduated scale on the base. This arrangement allows mitre cuts to be made without having to swing long stock out of line. There are two standard models: one for ferrous and the other for non-ferrous metals, the respective speeds being 27 and 54 meters per minute. An alternative model has a pole changing motor, enabling both speeds to be attained in the one machine. It is particularly claimed that the cuts are free from burrs. *J. C. Neville Limited, 34 Priests Bridge, London, SW14.*

ERROR BRIDGE

For Synchro Angles



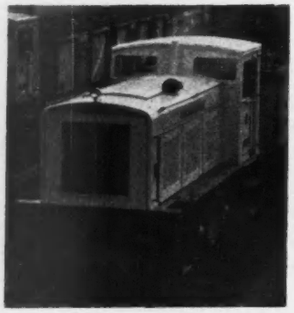
THE Theta system error bridge is designed to measure directly the angular position of synchros and resolvers without using any mechanical coupling.

The bridge is connected across the leads from the synchro and the angular position is displayed on three dials to three decimal places over a full circle. Readability is to 3·6 seconds of arc and accuracy is to within 20 seconds. The bridge elements have a high impedance so that no load is imposed on the synchro circuit. The instrument can also be used to simulate a perfect synchro or resolver input to a system. The new model ST-11C requires no auxiliary equipment to determine the steady state output position error of a servo.

A resistive network spans the synchro or resolver output connections. Taps are taken from the network at equipotentials for each 5° of rotor position. An additional network stage is inserted to correct varying output gradients at different taps. The in-phase component of the bridge output voltage is a linear function of rotor deviation from one of the 5° multiple positions and is compared to an a.c. voltage standard, capable of being shifted through 360°. A Kelvin-Varley circuit scales the voltage in terms of degrees. The noise components (quadrature and harmonics) are eliminated by a ring demodulator or phase sensitive circuit, the balance point being at centre zero on the meter scale. Each of the four read-out dials is operated in turn to bring the pointer to the zero position and will then show the synchro position directly. *Sylvan Ginsbury Limited, 8 West 40th Street, New York, NY, USA.*

SHUNTING LOCOMOTIVE

Diesel Hydraulic



A DIESEL-HYDRAULIC shunting locomotive has been added to the 165 range which already contains diesel-electric and diesel-mechanical models.

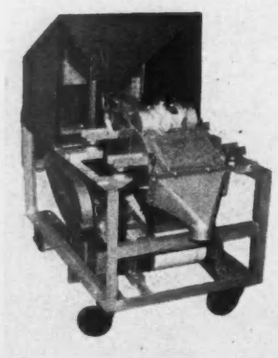
The locomotive is powered by the 6-cylinder YEXL turbo charged engine driving through a Twin Disc (series 10,000) three-stage torque convertor in conjunction with a reverse reduction gearbox. An air operated clutch isolates the engine from the hydraulic transmission for starting and reversing. The 165 DH is available with 0-6-0 wheel arrangement in gauges from 3 ft 3½ in to 5 ft 6 in; and in 0-4-0 arrangement for gauges from 4 ft 4½ in to 5 ft 6 in. The working weight of both is 28 tons.

The maximum starting effort of 16,200 lb can be attained with an adhesion of 578 lb per ton. At 1·5 m.p.h. a tractive effort of 13,700 lb is obtainable for an adhesion of 495 lb per ton. The figures are based on an engine output of 156 b.h.p. at 1,800 r.p.m. which obtains for temperatures up to 85° F and altitudes up to 500 ft.

The main frame is of steel plate, as also are the side panels and bonnet. A 135 gallon fuel tank is mounted on the bonnet structure. Full control is by three levers only, operating the engine speed and power, the reversing motion, and the brakes. They are duplicated to allow control from either side of the cab. Cab heater and windscreen wipers can be fitted if desired. A central control desk carries gauges and recorders. *Ruston and Hornsby Limited, Lincoln.*

FEEDER

With Screen and Magnet



A NEWLY developed feeder unit is portable and includes both a mechanical screen and a magnetic extractor for removing tramp metal.

The machine was originally designed for reclaiming flux after use in a submerged arc welding plant, but can be utilised for any granular material which is free flowing. A sheet metal hopper is mounted on the top of the machine, into which the material is placed. From there the material falls on to a vibrating feeder which can regulate the flow on to the vibrating screen placed below.

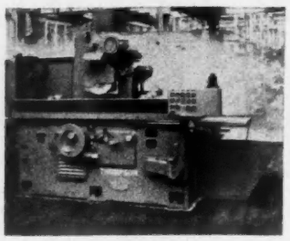
The screen, which can be fitted with a mesh of any required size according to the product being handled, gives a two part separation into oversize and fines; the former is rejected through the spout at the front of the machine and the latter passes through to a belt driven by an electric motor.

The belt carries the fines under a magnetic separator of the continuous discharge type and the finally purified material is deposited in a receiving box.

The machine has capacity of about 10 cwt per hour of material with a bulk density of 100 lb per cu. ft and operates from a three phase supply. Permanent magnets are used. The whole is mounted on castor wheels for moving from place to place. *Blending Machine Company Limited, Bond Street, Birmingham 19.*

GRINDING MACHINE

Using Preformed Wheels



NOW being made in this country by the Coventry Gauge and Tool Company, is the range of Thompson Truform grinding machines.

Truforming is a method of reproducing parts from a preformed crushing roll, the shape of which is first transferred to the grinding wheel and so to the workpiece. It is claimed that the crushing process gives a very free cutting wheel with a high rate of metal removal. Illustrated is the smallest of the range, the BT8-12-36, which has a table working surface of 12 in by 36 in. The wheel is 14 in diameter by 2 in wide and is driven by a 5 h.p. 1500 r.p.m. motor. Maximum height under the wheel is 16 in.

The machine incorporates the Hydra-Cool system for keeping the hydraulic system temperature down, so that any risk of distortion of the work table is avoided. The system allows only the required amount of hydraulic fluid to be pumped so that there is no wasted energy to be dissipated.

Infinitely variable table speeds are provided in the range from 3 in to 75 ft per minute. The table traverses on automatically lubricated V and flatways. An antifriction elevating nut is used on the wheel head and a micrometer back stop graduated in 0·0001 in divisions is fitted to the hand wheel. For crushing, the wheel is fed down under timed automatic control to the workroll at the right and can be reshaped until the roll loses its form. The wheel is then crushed on the master roll and used to regrind the work roll. This processing can be carried out without affecting the work setup. *Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London, NW2.*

TWIST DRILL GRINDER

With Projector

THE feature of a new Tatar grinding machine for twist drills is the built-in projector for checking the drill tip during the grinding operation.

The drill is mounted in a collet which is on two arms that can be swung to present the drill tip to either the grinding wheel or to the projector lens. It is shown in the latter position in the illustration. The wheel is driven by an electric motor built-in to the machine and it is claimed that a drill can be sharpened in 10 seconds.

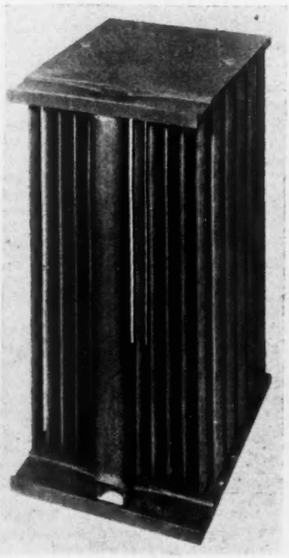
No centring device is required when mounting the drill in the collet and only one collet is needed to accommodate drills ranging from $\frac{1}{64}$ in to $\frac{1}{4}$ in in diameter. Both right and left handed drills can be sharpened equally well on the one machine.

There are two sizes of the machine being made: the smaller will take drills from $\frac{1}{64}$ in to $\frac{1}{4}$ in and the larger from $\frac{1}{64}$ in to $\frac{3}{8}$ in diameter. Lip angles can be cut on the drills of 90° and 140° and any desired clearance angle between zero and 30° can be obtained.

After each pass across the wheel, the drill is swung to a position in front of the projector lens so that a visual check of progress can be made. The magnification on the projector system is from × 10 to × 60. By rotating the drill a check of concentricity can be made. There is a vernier scale on the collet adjustment. *Alfred Herbert Limited, Coventry.*

SEPARATOR

For Corrosive Conditions



AN entrainment separator is now available made of impervious graphite in modular units.

The units are designed to separate entrained liquids from corrosive gas streams and have a high collection efficiency with a low pressure drop. The modules measure 1 ft by 2 ft and can be assembled into banks.

Operation is on the principle of impingement, coupled with venturi action. Staggered rows of teardrop shaped Karbate impervious graphite rods are cemented in place with a minimum of ¼ in clearance to reduce clogging. The arrangement prevents straight line flow but the open diagonal lanes permit cleaning. The streamline retards re-entrainment and cuts resistance to gas flow. There are two styles: type A for single row installations or top rows of larger assemblies; and type B (illustrated) for lower rows, being fitted with a gutter and downpipe for drainage. *Union Carbide International Company, 30 East 42nd Street, New York, NY, USA.*

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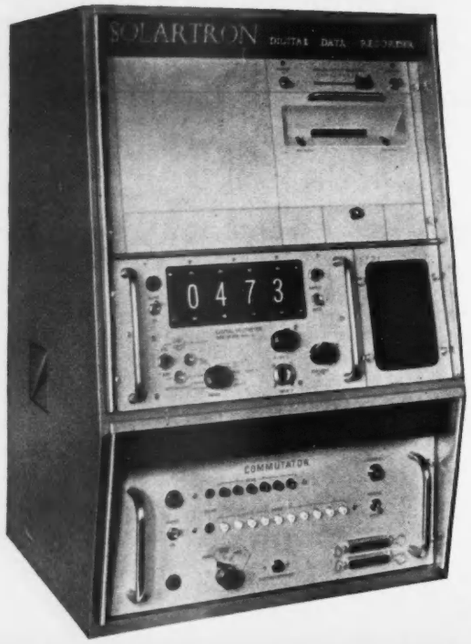

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Human Element

International Apprentices Competition

FINAL selection is now beginning for the British team to compete in the Inter national Apprentice Competition in Barcelona at the end of September.

From a small British entry in 1955, when eventually only one competitor was entered, the interest of United Kingdom firms has grown steadily until this year 76 firms have put forward their apprentices—a total entry before elimination of 220 candidates from 17 trades.

Thirty-two boys will make up the final team. The official entry has to reach the International Organising Committee in Barcelona by 20 August.

The importance of the competition in giving apprentices a sense of competition—and a trip to Spain to compete for—is self-evident. The benefit in improved standards of skill may reasonably be expected to spread steadily outwards from the firms where enthusiasm about training is high enough to lead to participation in the competition.

Other countries also see the value of competing. Starting as a purely national competition in Spain in 1947, the contest was widened in 1951 so that the Spanish boys should compete with Portuguese apprentices who had been through a similar series of tests.

Later the competition was opened to any other country wishing to take part. The British entry has risen from one in 1955, to six in 1956, twelve in 1957, twenty-one in 1958, twenty-three in 1959, and this year's team will be almost half as large again with thirty-two.

Western Germany, Italy, France, Switzerland, Belgium, Holland and Ireland are also taking part. Next year the competition is expected to be held in Duisberg, Germany.

The United Kingdom companies who have put forward candidates include the Appleby-Frodingham Steel Company, the Atomic Weapons Research Establishment, Babcock and Wilcox, British Timken, the Central Electricity Generating Board, Sidney Delton (Jewellery), Distillers, Engineering Service Installations, English Electric, Guest Keen and Nettlefolds, Kodak, Joseph Lucas, Metal Box, Mullard Radio Valve, C. A. Parsons, Renold Chains, Rolls-Royce, Skefko Ball Bearing, John Thompson, Wakely and Wheeler, Silversmithery.

Good Response to Scots Industrial Survey

Are the Scots more conscientious in answering questionnaires? Apparently the answer to this may be that they are. The Scottish Council (Development and Industry) inquiring into the country's national economy has had a 78 per cent return from Scottish firms and 87 per cent from local authorities.

Regrettably, the response from English organisations that have moved into Scotland has been disappointing. The general level of replies from companies that have established themselves north of the border from overseas has not been very encouraging either, although firms from the United States have been rather better, reaching a level of 65 per cent. Which, by most survey returns, is reasonably high. The Scottish Council, incidentally, are going to remind those tardy with their answers.

The Council's questions, eliciting confidential information from industry and local councils, are designed to lead to a modern picture of Scots industrial activities and the special needs of the economy. When the replies have also been received from later questionnaires, sent to employers' associations and trade unions, they will be sent to a research team at Glasgow university. It is hoped that the university team will have brought order to the assembled information by October and the committee will then be able to begin drawing up their report.

First Year Apprentice Training Scheme

Whether or not the small-scale engineering firm that says it cannot afford to release an apprentice for a year's full-time training is being short sighted, it is certainly true that the small company that does give an apprentice such intensive instruction is safeguarding its long-term interests.

There is a risk that the apprentice who is given real training during his term will leave for a bigger works and greater opportunity later on. That argument has holes worn in it, partly by time and equally by the likeliness that if the apprentice was going to move he would go, training or no.

It also flies in the face of the known fact that the firm which has contributed towards a man's training is likely always to have some place in his regard; more generally, there is the overall gain in engineering skill.

At the Government Training Centre, Leeds, there are currently a dozen places for full-time first-year training for apprentices. What might the tangible gains of sending a 16-year-old on the course be to the small engineering firm?

In the first place, at the end of twelve months, the firm would have an apprentice with experience and practice of drilling, shaping and similar operations. And they would also have an apprentice beginning his works experience who took his apprenticeship as a serious training and not merely a vague introductory period.

Whether the dozen will be found is as yet uncertain.

Course for Safety Officers

A safety officers' one-week residential training course at the Sunningdale, Berkshire, Civil Defence Staff College, is to be held in November by the Royal Society for the Prevention of Accidents.

The course will be specially concerned with the prevention of accidents in the building and civil engineering industries.

Practical lectures on those features of building work which are capable of being demonstrated will be added to talks on safety organisation, accident causes, lifting appliances and on demolition.

In one practical session the safety officers will be asked to find and correct faults in scaffolding. This period will be taken by Major D. K. Edwards of Scaffolding (Great Britain) Limited.

Enquiries about the course, should be made to the Training Officer, RoSPA, Industrial Safety Division, Artillery Mansions, 75 Victoria Street, London, SW1.

New President of Foundrymen's Institute

The President for 1960-61 of the Institute of British Foundrymen is Mr. G. R. Shotton, a member of the Institute's technical council for almost 30 years and the general council for 17.

Mr. Shotton is managing director of Shotton Brothers, of Oldbury, a subsidiary of the Birfield group. A Fellow of the Institution of Metallurgists and of the Institution of Works Managers, Mr. Shotton has been in the ironfoundry industry since 1924 and with Shotton since 1928.

A past chairman of the Automobile and Allied High Duty Ironfounders' Association, the new president is also a member of the council and research board of the BCIRA.

Its All Chinese to Them

The furious pace of industrial activity in China is seen as something of rather more than vague, long-term importance in Sheffield.

In the steel centre it is well known that some significant technical advances have already been brought off in the Chinese industry. Steps are now being taken to keep very much more than an eye on its progress.

At the local college of technology this September, steel research workers from Sheffield will be starting their first lessons in Chinese in order to read the technical literature at first hand. The inspiration for what must be an arduous course if it is to succeed comes from Mr. Robert Sewell, the information officer for the United Steel Companies.

Mr. Sewell, who is himself multilingual, acknowledges that a great deal has been learnt from Russian technical journals and from second hand reports about Chinese industry. He believes that it is now time to get into a position where information about the steel-making activities of the Chinese is not dependant upon translations.

30 Minutes Less Work and More Pay

The average weekly pay packet for manual workers in the manufacturing industries and an important group of non-manufacturing activities has increased by 7·2 per cent over the past year, to £14 2s 1d. This was the figure quoted by the Ministry of Labour for the last pay week of April. It is almost a fifth higher than four years ago.

The average weekly hours were exactly the same as a year ago, 48·0, although that figure is half an hour down from the 48·5 average of October, 1959.

The more or less steady level of average hours worked in the manufacturing industries indicates that, as the employers forecast, the effect of reducing the basic working week has had its only direct effect in increasing overtime payments.

The Ministry's averages are drawn from seven million workers. The non-manufacturing section includes mining and quarrying (excluding coal), construction, gas, electricity and water, transport and communication (not British Road Services or London Transport) and public administration.

While the level of weekly earnings for men is now 19·7 per cent above that of four years ago, the level of weekly wage rates for men is up over the same period by 13 per cent.

When the comparison is limited to the manufacturing industries only, an increase of 4·3 per cent over the previous six months is shown, to £14 16*s* 4*d*. The earnings of women in the manufacturing industries rose in the same six months by 2·7 per cent, to £7 5*s* 2*d*. The average weekly hours of women in the manufacturing section are 40·6, against the average for men of 47·4.

General Survey of the Holiday Problem

By the end of this month the Government hopes to have gathered in the replies to its 3,000-firm survey of industrial holiday habits.

The Ministry of Labour has sent its questionnaire to 3,000 companies making up what it believes to be a representative cross-section of the working population. The results, which will be taken as being the view of industry on the problem, will be submitted to the interdepartmental committee set up by the Government.

The question of extending the holiday season has been referred by the National Joint Advisory Council to the Joint Consultative Committee for detailed investigation. All grades of employee are covered by the questionnaire and firms are asked whether, where school holidays prevent them moving their closing dates, they would consider a change if the school holidays were altered. Companies closing completely in July or August have been asked to give the reasons for difficulties they would expect from closing down at another time.

Many such reasons will be given but it is doubtful whether in the end they will succeed in holding back the tide. More and more people can afford to go away for their fortnights holiday. The three-week holiday is gaining ground fast, increasing the pressure.

There is no known way of increasing the size of Britain's holiday beaches and foreign holidays are not yet increasing at a rate to equal the number of holidays sought by families staying within the United Kingdom. For the moment the burden is carried by the holidaymaker who simply suffers a less enjoyable holiday.

But that means the employer paying for the holiday is not getting value, in a refreshed employee, for his money.

May is often a very sunny month, and September as a holiday month has the advantage of giving a break just before the winter starts. Nobody, except the children, wants the schools to break up from May to the end of September, but is there any reason why the area of half the university examining boards of Britain, and all the works within them, should not be on holiday in June and July, and the other half take their vacations in August and September?

Changing the order each year would perhaps help, although it would also make for even more protests from the education authorities.

Congestion May Revive the Battery Car

An economical electric car using commercial storage batteries can be designed for a range of 30 miles with a top speed of 30 m.p.h. Use of electric cars would reduce noise, fumes and congestion in cities, and improve the load factor of electricity suppliers.

P. G. Boyd, B.Sc., M.E., M.I.E.E.

THE earliest self-propelled vehicles were battery driven—by primary batteries driving iron bar armature motors. This was about 1840. About 1860 secondary batteries were developed, but they had to be charged from primary batteries as dynamos had not yet been invented. The first practical battery-driven cars were produced in 1886 and before the end of the century the coveted speed of a mile a minute was exceeded for the first time by a battery driven car. Later a battery driven car did a record distance of 225 miles on one charge. Steam cars were also developed and for a while steam held the land speed record. Soon there were rapid developments in petrol engines, and mass-produced vehicles became available at low prices. Today we have no steam cars and battery propulsion is used only for vans and trucks on low speed applications where there are frequent starts and stops.

No doubt, battery manufacturers envied the success of the internal combustion engine, but they found a growing demand for batteries in electricity generating stations and elsewhere as alternating current electricity was then only in its infancy. By 1912 internal combustion engines were so large that a battery and starter motor became necessary. It is difficult to see how we could have today's cars without their batteries and the electrical essentials they make possible. It is interesting that nowadays the market for batteries for internal combustion engine vehicles is the battery manufacturers' largest market; it is likely to remain so.

Many remarkable scientific and engineering developments have taken place in the last few years: nuclear power, the Wankel engine and the multi-fuel engine, to name a few. Our roads are crowded by petrol-engine powered bicycles, scooters, motorcycles and cars. Some of these vehicles are capable of a safe 100 m.p.h. on motorways. But all of them spend much of their time travelling at less than 30 m.p.h. in cities and towns, or stationary with their engines ticking over in traffic jams for about one-third of the journey time. It is truly amazing how the many shortcomings of the internal combustion engine for traction purposes have been overcome, but the engine has still many shortcomings for city use.

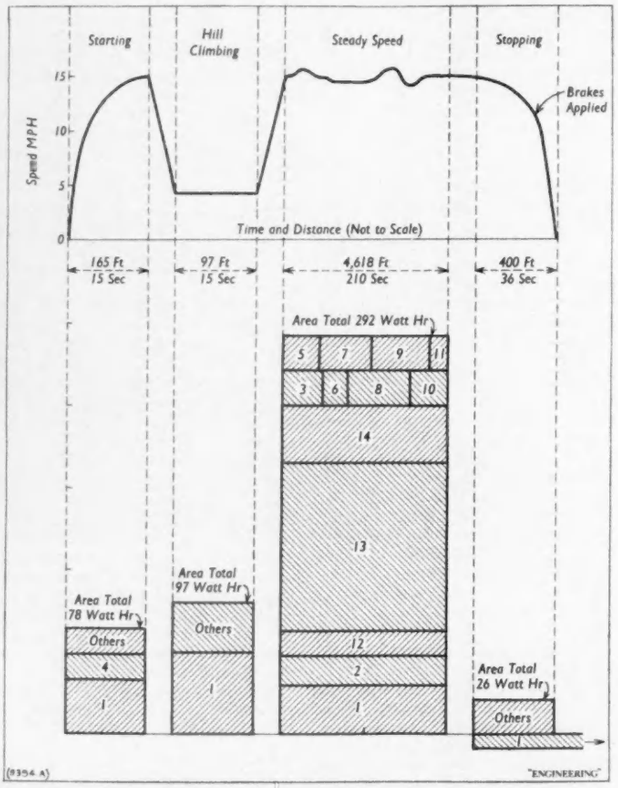
Under these circumstances it is considered that there is a market for a battery driven car. It is thought that a small two-seater, capable of 30 m.p.h. and 30 miles per charge, would have widest application. Such a car could be produced today without waiting any longer for the revolutionary battery which may never come. This car would satisfy its owners both on the score of performance and costs. Furthermore, it would assist materially in reducing today's and tomorrow's many transport and traffic problems and it should find support from many who are advocating greater road safety, noise abatement and the reduction of atmospheric pollution.

In the past 100 years there have been many improvements—progressive if not revolutionary—in batteries, chargers and electric motors. Even during the past year there have been improvements in batteries. But the size of a battery (and therefore its weight and price) for all traction applications is still large. The size of the battery required (in terms of its watt-hour capacity per discharge) is proportional to the product of the gross weight of the vehicle including the battery itself, its speed and range. It is thought that the ideas of exchanging discharged for charged batteries, rapid charging, regenerative braking, using a petrol engine-driven generator plus battery on the vehicle, etc., are unlikely to have frequent useful application. A small Wankel engine coupled to a high speed electric generator and to an expensive silver-zinc battery might prove an exception for some special applications.

There are many reasons why the proposed battery car should be small and of low speed. First, a two-seater, with some space for luggage or two children, would be smaller and lighter than, say, the BMC minicars, and would therefore require a smaller battery than a car loaded with four adults. It is realised that a four-seater would have wider application than a two-seater, but many cars in city use often carry only the driver. The small dimensions of the proposed car, dictated by the battery, are offset by much lower purchase price and lower space requirement in traffic, parking and garaging.

A genuine maximum level-road speed of 30 m.p.h. is thought to be adequate, but this should be coupled with (*a*) maintaining 30 m.p.h. on normal uphill gradients and (*b*) sports-car acceleration from rest to 25 m.p.h. These two requirements are essential even though they would reduce the range per charge. 30 m.p.h.

This home-built toy battery-car accommodates six small children. On the road it carries two adults at 10 m.p.h. for 10 miles. A pennysworth of electricity recharges the battery.



(Right) Analysis of losses in an electric van. For key, see the Table on the opposite page.

POSITION IN 1960

The battery car envisaged would have a world-wide market for city and suburban use; it would be complementary to petrol engined vehicles. It is therefore not surprising that during the past year there has been considerable interest both in Europe and America in battery driven cars. Many experimental models have been proposed and constructed but none is in commercial production. At present it seems unlikely that the fuel cell will prove suitable for small vehicles used for personal transport.

would suffice for present traffic conditions; and would increase road safety by limiting the danger of higher speeds—whether the driver be young or old, intoxicated or inexperienced, or merely a good driver in a hurry.

Thirty miles per charge would be adequate for many city and suburban users as many petrol cars normally do less than thirty miles daily. The battery would be charged at night time, requiring about ten hours. Contrary to several recent proposals, it is thought that the battery charger should not be carried on the vehicle ordinarily, only occasionally in order to allow topping-up charges. In this way, if the car were required to cover say 60 miles, this could be achieved in a time of about three hours running and three hours charging, assuming that electric mains are available.

ADVANTAGE TO THE OWNER

Economy would be one of the biggest advantages of the battery car. The total standing and running costs in Britain in 1959 for 10,000 miles mixed running annually have been estimated by the RAC as 7*d* per mile for cars up to 1·1 litre, and 31*d* per mile for cars up to 4·5 litres. For city running these costs would be higher. The corresponding estimated total running cost for the proposed battery car would be 2*d* per mile allowing for battery renewal every six years. The cost of electricity for the battery car is almost negligible, being only about 0·3*d* per mile. Not even the smallest petrol engined bubble cars and scooters could beat this figure in city use. It will be seen that one could save money, and of course enjoy other advantages, by owning a battery car to supplement the family petrol car.

But perhaps the greatest advantage of the battery car would be its "driver appeal": as silent and vibration free as a Rolls Royce and much easier to drive. An American has said that the battery car appeals because one presses a switch and the car starts "all over" instantly, in all weathers; with no clutch or gears to fuss about. This would be a load off the minds of many drivers both good and bad who have no wish to learn how their cars work. The battery car could score heavily on all other mechanically propelled vehicles in matters of reliability, long life, low costs for service and repairs. It could be fully guaranteed, including its tyres and battery, for four years. Its purchase price could include the cost of servicing monthly (topping-up battery and checking) and lubricating and adjusting annually for the four years. The servicing envisaged could be organised by the battery manufacturers and electricity supply authorities.

The car should be designed for garaging outdoors—at the owner's doorstep. To prevent electric shock its mains charger should be kept indoors and the low voltage charging cable (under 50 volts) brought outdoors to the car. Uniquely the battery car could have an electric heater which would heat the car immediately, even before starting, and the battery power could be used to advantage sometimes for other purposes.

The successful battery car will not be a converted petrol engined car, nor will it be a modified battery driven van. It must suit its purpose in all respects and it should be easy to look at for many years. It should be carefully designed down to the last detail, including a concealed front towing bracket as the battery will go flat on the road occasionally.

The low maximum speed of 30 m.p.h., and the small variation between minimum and maximum gross weights would simplify steering, springing and braking problems. Minimising dead weight by all the modern aids would be as important in the proposed car as in aircraft.

Not less important than minimising dead weight is minimising transmission-gear and tyre rolling friction losses. It is thought that the best solution to these problems might well be a combined motor, transmission-gear and road wheel arrangement, which has not been used up to now in any road vehicle. The wheels need not be quickly removable; they need not all be the same size; even a spare wheel would be unnecessary. The tyres should be large diameter, high-pressure type to minimise rolling resistance. Air friction resistance should be reduced to the extent of minimising the car's frontal area. Streamlining to make the car look as if it could do 100 m.p.h. would not be justified, particularly as easy entry and exit even for elderly adults is essential. In the latter connection a centrally-hinged tiller-bar, on which control switches could be mounted, instead of the usual right or left hand steering wheel would have advantages.

On the electrical side all the losses must likewise be minimised and it might be found that instead of the usual reversing series-wound motor, with fixed ratio transmission gear and perhaps series/parallel control, a more efficient arrangement, yet simpler both to manufacture and control, would suit the proposed car.

ESTIMATING LOSSES

The battery charger, with its automatic charge control relay, and also the battery, and its instructions, would need some alterations from those now used in order to make them suitable for individual car owners instead of fleet users. The car must be provided with an arrangement which would indicate the mileage which can be covered before the battery is discharged.

The charger and the flexible cable and plug which connect it to the car must be interlocked to prevent incorrect use in the hands of non-mechanical minded and careless users. Likewise all the controls on the car should be interlocked and they should also be as simple as possible.

Since both the speed and range of battery vehicles are limited by the magnitude of the various losses in the vehicle it would be imperative that all the separate losses are estimated for various design arrangements and various operating conditions, i.e. varying road speeds, gradients, wind, load, etc. The accompanying diagram and table give a break-down of the losses into 15 headings in a typical battery driven van for a journey of one mile under the conditions indicated. A similar break-down of the losses for the suggested car could be made for its full range of about 30 miles—again under differing operating conditions. It will be found, particularly for the fast discharge rate envisaged in the car, that the greatest loss is in the battery itself because it will give much less than its nominal rated watt-hour capacity.

TABLE.—*Estimated Losses in a Battery-driven Van, with a Gross Weight of 2·4 tons, for a Run of One Mile Under the Gradient and Speed Conditions shown in the Diagram on the opposite page*

Source of loss	Starting		Hill climbing		Steady speed		Total		Stopping	
	Watt-hours	Per cent of 77·7 watt-hours	Watt-hours	Per cent of 96·6 watt-hours	Watt-hours	Per cent of 291·9 watt-hours	Watt-hours	Per cent of 466·2 watt-hours	Watt-hours	Per cent of 26·4 watt-hours
1. Battery	42·5	54·6	60·2	62·1	36·8	12·6	139·5	29·9	Negative loss	
2. Battery tapping	1·5	2·0	1·5	1·6	21·0	7·2	24·0	5·1	3·6	13·6
3. Lead resistance	1·8	2·3	8·4	8·7	6·3	2·2	16·5	3·5	0	0
4. Starting resistance	18·0	23·0	0	0	0	0	18·0	3·9	0	0
5. Motor field	1·8	2·3	8·3	8·6	6·2	2·1	16·3	3·5	0	0
6. Motor armature	1·1	1·4	6·1	6·3	3·9	1·3	11·1	2·4	0	0
7. Motor brush volt drop	1·0	1·3	2·2	2·5	7·0	2·4	10·2	2·2	0	0
8. Motor brush friction	0·4	0·5	0·2	0·2	9·6	3·3	10·2	2·2	0·9	3·4
9. Motor bearing and windage	0·4	0·5	0·2	0·2	8·8	3·0	9·4	2·0	0·8	3·0
10. Motor iron	1·3	1·8	2·5	2·6	5·2	1·8	9·0	1·9	0	0
11. Motor stray load	0·3	0·4	0·4	0·4	1·9	0·7	2·6	0·6	0	0
12. Gear friction	2·5	3·2	3·9	4·0	18·6	6·4	25·0	5·4	0·8	3·0
13. Tyre resistance	4·5	5·9	2·5	2·6	125·0	42·8	132·0	28·3	10·9	41·4
14. Wind resistance	0·6	0·8	0·2	0·2	41·6	14·2	42·4	9·1	1·4	5·3
15. Mechanical brakes	0	0	0	0	0	0	0	0	8·0	30·3
Total losses, watt-hours	77·7	—	96·6	—	291·9	—	466·2	—	26·4	—
Total percentage	—	100	—	100	—	100	—	100	—	100
Percentage of 466·2 watt-hours	16·8		20·7		62·5		100		—	

A one-ton battery van made by Smith's Delivery Vehicles Limited used as a mobile post office. It is typical of the 30,000 such vehicles at present in use in Britain.

THE FUTURE

Correlated research, design and testing is necessary before the battery car becomes a reality. None of this work is difficult or likely to be expensive. It is thought that there would be a world-wide market for the car as, assuming mass production, it should sell, complete with battery and charger, for less than petrol-engined bubble cars.

The greatest application for the proposed car would be as a second or third family car. A slightly modified version of the car would have wide application as a light goods van and for tradesmen and others making house to house calls. The car would also have special applications such as invalid cars, personnel carriers, and golf carts, etc.

It has been suggested that private cars should be forbidden in city centres with acute traffic congestion, and that small battery cars should be made available on hire at the city outskirts. About four battery dodgems could be accommodated in the road area occupied by one large car which perhaps contains only the driver. The battery cars could be hired from city corporations or transport authorities.

It is probable that electricity supply authorities would permit private car owners to charge their batteries from their present domestic meter circuits, in which case the consumer's annual consumption would be about doubled without any additional expenditure by the electricity authority. The battery charging load (about 3,000 kWh annually, with peak load of about 1 kW) has a very good load factor; it would be maximum in summer and received at night. This feature is likely to be even more important in future when more electricity will be generated from nuclear power stations.

Thus in addition to low cost transportation, the battery-car offers unique third party advantages: improvement in electricity load-factor, reduction in fuel-oil imports, elimination of noise and fumes, and alleviation of the traffic problem by providing a car that is tailor made for city use. The attractiveness of these cars to electricity supply authorities has been indicated. No doubt battery manufacturers would also be interested. If the battery car is to become an accepted mode of transport, it will be necessary for these interested parties to get together with a leading motor-car company to finance, develop, manufacture, sell and service such a vehicle.

Work at the Building Research Station

All aspects of the structrual and functional behaviour of buildings are studied at the Building Research Station. Many of the findings find their way into Codes of Practice and British Standards.

THE Building Research Station of the Department of Scientific and Industrial Research has issued a general report—the third in the series—reviewing the work at the Station. The following paragraphs are abstracted from the report.

Lightweight Aggregates

Recent work on reinforced concrete has been concentrated on lightweight aggregates and on shear. An increase in the production of reliable light weight aggregates in this country has prompted an extensive investigation into their use in reinforced concrete. The first results of this work do not yet permit an exact prediction of the degree of protection against corrosion afforded by lightweight concrete, but they do suggest that corrosion is influenced more by the thickness of the cover provided and the quality of the concrete than by the nature of the aggregate. Comparative tests, using normal and lightweight aggregates, on reinforced concrete beams designed to fail by a breakdown of the bond between the concrete and round mild-steel bars, show that the bond strength developed by lightweight concretes is less than that developed by a dense concrete of the same crushing strength. The bond stresses permitted by CP 114 should therefore be reduced.

The influence of shear on the strength of normal reinforced concrete beams is much more complex than current Codes of Practice imply. There are so many interacting variables that a comprehensive and practical method of design for shear is not easily arrived at and the relevant recommendations of the current Code do not appear to be adequate. For practical purposes a beam may be considered to have failed in shear when a main diagonal crack has developed, though the load at which this occurs may be less than the maximum load which the beam could sustain. Using this criterion of failure, if a pulsating load is superimposed upon a static load representing the design dead load, the highest value which can be applied for one million cycles without such cracking is only about 70 per cent of that sustained in static tests. A static loading test was also made on a specially prepared beam in which a thin former was used during casting to produce two smooth-sided cracks, similar in extent and position to the flexural cracks observed in other beams just before the onset of the main diagonal crack. The low failing load compared with that of a normal beam suggests that the forces developed by the interlocking of the aggregate along flexural cracks play an important part in determining the load at which the diagonal crack that will ultimately cause failure is likely to appear.

Column Encasement

Structural research at the Station is aimed partly at extending the general body of structural theory and partly at codifying this general body of theory into Codes of Practice and similar Standards. Some programmes are undertaken specifically to help in the redrafting of a particular Code. A recent example has been a series of tests designed to check one of the revisions in the latest issue of BS 449, *The Use of Structural Steel in Building*. This relates to the load-carrying capacity of concrete-encased steel stanchions subjected to axial and eccentric loading. In the 1948 edition of the Standard, the only structural benefit the designer could derive from such encasement was a reduction in the assumed slenderness ratio of the stanchion due to the stiffening effect of the concrete. It has been shown that such stanchions can in fact be safely treated as composite sections in which a proportion of the direct load is carried by the concrete, acting at a stress of one-thirtieth of that in the steel. In the latest version of the Standard, design on this basis is allowed with the proviso that the working load shall not exceed twice that of the corresponding bare steel stanchion. This can result in savings of up to 30 per cent in the weight of steel section required.

Wind Loading

Wind loading, on buildings can present many different problems. A *Digest* recently issued by the Station explains how the result of meteorological observations have been interpreted in the design recommendations given in CP 3, Chapter V. The *Digest* also discusses the results of recent wind-tunnel tests on models of rectangular buildings with mono-pitched roofs with little slope, which show that with this form of construction the most severe conditions are likely to occur when the wind blows obliquely to the faces of the building. A more reliable method of estimating the wind forces on flat and shallow pitched roofs is proposed, to be used in conjunction with a load factor of three against uplift and overturning.

Clay Strengths

The Soil Mechanics division of the Station has investigated the mechanical and physical properties of London clay at depths between 50 ft and 160 ft. The properties have been determined from samples taken at the working face during tunnelling operations at a number of sites, and also by a study of the appearance of the working faces as mining proceeded. The importance of this type of investigation to supplement the findings of borehole exploration is twofold. First, visual observation at the tunnel face can throw light on structural characteristics of the formation that are not revealed by normal boring methods; and second, the opportunity can be taken to obtain relatively large samples for laboratory tests with the minimum risk of disturbance. Tests on specimens prepared in this way expose some shortcomings of the use of bored samples for the determination of physical characteristcs, and indicate that the clay is stronger and less compressible than these samples suggest.

Factory Layout

A new series of papers under the general title *Factory Building Studies* is being prepared that will deal with many aspects of factory design. In the first, the particular case of the multi-storey factory is discussed, and the wide range of considerations that can influence both its main conception and the finer points of detail is outlined. Multi-storey construction may sometimes offer immediate economic advantages in terms of factory organisation and initial cost, but its long-term efficiency depends largely upon the extent to which changes in functional requirements can be predicted and accommodated. An adequate appraisal of the effects of possible changes in manufacturing techniques is therefore a prerequisite of a satisfactory design.

The fourth study of this series deals with design loads. Self-weights of the structure and its cladding should be simple to estimate, but this is not true of the superimposed loading. This loading may arise from so many different sources, temporary or permanent, that it is difficult to assess it with the accuracy that is desirable for economic design. To assist in this assessment, data have been compiled on the loads imposed by many types of machine, ancillary plant, service equipment and fittings. The importance of anticipating future require-

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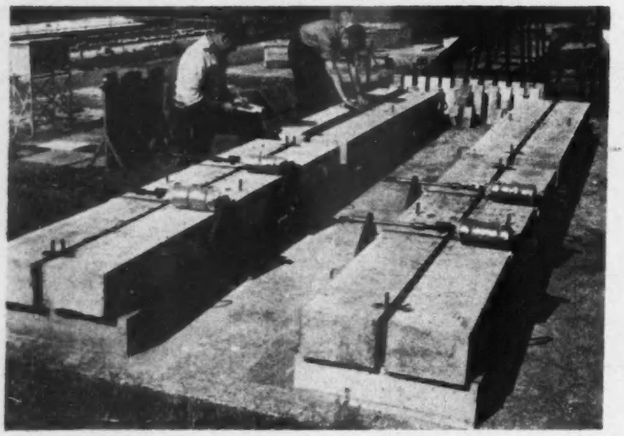
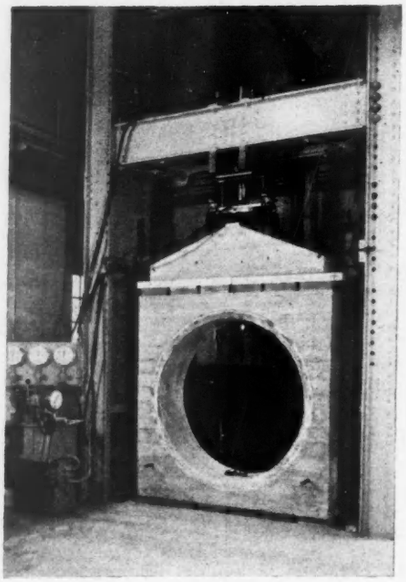


(*Left*) *Tests to compare the long-term outdoor behaviour of similar reinforced concrete beams, cast with different aggregates, three lightweight and one normal. Each of the nearer beams has been loaded initially until it cracked and then kept under load.*



(*Right*) *Loading test on a section of concrete pipe of 60 in diameter with a 6 in site concrete surround.*

Separation Compound for Concrete Work

In the construction of multi-storey buildings by the Lift Slab principle, it is necessary to use a separation compound that will allow concrete slabs to be cast one on top of another with the minimum of inconvenience. The Lift Slab method has been used in this country for the construction of the new factory for Texas Instruments Limited at Bedford (ENGNG., vol. 189, p. 820, June 17, 1960). By this method, the columns of the building are erected, all the floors are cast at ground level and then raised by jacks to their final positions.

At Bedford, the separation compound used was Tretol Separation Membrane and Curing Compound, originally prepared by the Servicised Products Corporation of Chicago and now manufactured and distributed by Tretol-Servicised Limited, 2 Caxton Street, London, SW1.

The compound is applied by spray after the finished floor slab has been trowelled, using an ordinary hand spray; a fine mist is recommended and it should be applied in long sweeping strokes with some overlapping. One gallon should be used for every 250 sq. ft and the coating will harden overnight.

Before proceeding, the prepared layer should be swept clean, special inserts or boxes put into position, and another coat of the compound applied, thinner than before. If the coatings are damaged while fixing the reinforcing steel, the damaged area can be re-coated using a small paint brush to apply the compound. Spraying timber shuttering will seal the surface to moisture and assist with stripping.

The compound disintegrates with time by natural oxidation by the air, but if its removal has to be hastened breakdown can be promoted with a power driven wire brush or by the use of a paint stripper.

Continuing Work at the BRS

ments, rather than designing solely for the present, is stressed.

Pipeline Construction

Research on public water supply and drainage is proceeding along several lines. The high incidence of failures in underground drainage pipelines not due to faulty workmanship has prompted a detailed investigation into their design and construction. This has involved numerous laboratory tests using both ceramic and concrete pipes, and also a study of a large number of failures that have occurred in practice. Recommended laying procedures have been devised which, in some cases, depart markedly from current practice. With both concrete and ceramic pipes, the difficulties of making the pipeline sufficiently strong to withstand the many combinations of loading that may be imposed on it are increased if rigid joints are used. By the use of rubber flexible-telescopic joints, some displacement of line of one pipe relative to the next, such as may result from local earth movements, can be safely accommodated, and the risk of failure due to thermal and moisture movements is reduced. For these joints to be effective, any concrete bed beneath the pipes must be discontinuous where the joints occur. A further advantage of their use is that time can be saved and the risk of damage reduced by testing and backfilling immediately after completion of each section.

The laboratory tests have shown little justification for the practice of providing *in situ* concrete surrounds for large-diameter concrete pipes. Under normal site conditions, the benefits are likely to be small in relation to the cost, and pipes that are sufficiently strong in themselves are to be preferred. Such pipes are now available in this country.

Domestic Plumbing

Studies relating to domestic plumbing and sanitation have shown that the consumption of water has increased so much in recent years that wastage by the consumer has become a much more serious matter. It can arise either from defects developed in an appliance or through the use of an appliance that is inherently wasteful. To reduce such waste, attempts are being made to improve the design of fittings. In the design of above-ground drainage systems, the application of scientific principles has already led to considerable economies, and attention has recently been focused on the possibility of extending the now familiar "single-stack plumbing" system for two-storey houses to high flats and public buildings. Recommendations are given in a Station *Digest* No. 127.

Full details of all the publications from the Station can be obtained from the Director, Building Research Station, Garston, Watford, Hertfordshire.

International Research for Road Safety

Delegates from thirteen member and associated countries of OEEC have recommended that an international body should be set up to foster road safety research. This decision was taken during a four day meeting held last month at the Road Research Laboratory, of the Department of Scientific and Industrial Research, at Langley, Buckinghamshire. The countries represented, in addition to the United Kingdom and the United States, were Austria, Belgium, Denmark, Spain, France, Greece, Italy, Norway, the Netherlands, Sweden and Switzerland.

The meeting also recommended that each country should set up its own national committee for road research which would, additionally, provide the link with the proposed international body.

Topics that would benefit from international cooperation were discussed and some are listed below. Several are already being investigated, some of them at the Road Research Laboratory.

(1) Priority rules for traffic meeting at an intersection.
(2) Road user behaviour, such as where pedestrians should cross the road and the care they should take before so doing.
(3) Road furniture (lamp standards, sign posts), kerbs, etc.
(4) Comparison of results obtained by accident investigation teams in the different countries.
(5) Examination of accident data on the effectiveness of seat harness, and similar information on crash helmets for motorcyclists.
(6) Speed limits and accident frequency, especially in towns.
(7) Effects of alcohol and drugs.

Flatter Gradients Cut Pipeline Excavation

Pitch fibre drain and sewer pipes can be used at gradients as low as 1 in 85 for 4 in pipes and 1 in 145 for 6 in pipes. By using these new minimum gradients, instead of the conventional figures of 1 in 40 and 1 in 60 for 4 in and 6 in pipes respectively, as required by the McGuire rules, up to 50 per cent can be saved in excavations. The new gradients are based on a flow velocity of 2·5 ft per second at a quarter depth of flow in the pipe, which is the self-cleansing condition indicated by the Code of Practice for Building Drainage (CP 301). The above information is given in the second issue of *Pitch Fibre Progress*, the Quarterley Newsletter of the Pitch Fibre Pipe Association of Great Britain.

The factual evidence for making the changed recommendations was taken from two reports of the Hydraulics Research Station: HRS Research Paper No. 2, 1958, *Charts for the Hydraulic Design of Channels and Pipes* and an HRS special report entitled *The Roughness of Pitch Fibre Pipes*. The improved gradients are possible because of the smoothness of pitch fibre and the small disturbance that is occasioned by the joints which have only small, if any, internal gaps and, because of the long pipe lengths available, the relative infrequency of the joint.

Extended Facilities for Hydraulics Research

The Hydraulics Research Station of the Department of Scientific and Industrial Research, at Wallingford, is to be enlarged, particularly by extending the main hall. Into the main hall, too, is to be built a wave basin, 270 ft long, part of which will be set aside for background research on coastal erosion; the remainder of the basin will be employed on investigations of wave disturbance in harbours and allied problems. The work on the hall should be completed by the end of the year.

This news is given in the Hydraulic Research Board's report just published (HMSO 5*s* 6*d*, plus postage; USA 99 cents) which also contains the directors' report on the work of the station during 1959. This covers both fundamental research and model investigations for projects at both home and overseas.

A good example of the medium size project that can be tackled with advantage by the Station is the study made of a four mile long stretch of the River Trent at Burton-on-Trent, an area frequently affected by bad flooding. In recent years accumulating mud in the slower flowing channels has made some of the riverside areas—once a valuable amenity—far from pleasant.

The river levels have been controlled by a series of weirs, but the model study showed that the flood levels can be improved by the removal of a derelict weir (at Drakelow), the closing of certain channels and the realigning of others. These works will all help to increase the flow velocities through Burton so that less silt is deposited.

Making up Private Streets

One of the many problems facing local authorities is the making up of private streets to acceptable standards of construction at a reasonable cost to the frontagers. Recommendations for this work are given in a new Road Research note, No. 26, entitled *A Guide to Engineers on the Making up of Private Streets*. It is published for the Department of Scientific and Industrial Research by the Stationary Office, price 1*s* (by post 1*s* 2*d*) and 30 cents in the USA.

The economies recommended are based on the experience of local authorities and can be effected by making use of existing construction as well as cheap local materials in all new road works.

The note is concerned only with roads carrying light traffic of up to 45 commercial vehicles (of unladen weight exceeding 30 cwt) each day.

Machine That Builds Houses

In Moscow there is said to be at work a machine that can "build houses." It is in use on the construction of a five-storey block of flats, attended by a gang of only eight men.

The machine differs in its abilities from more conventional cranes in that it can do "all the jobs of assembly, not merely the hoisting of walls and other building elements into position." It can be used to erect brick-built houses as well as large-panel and prefrabricated room-at-a-time buildings. Its designer, a Vladimir Popov, claims that it is the first machine to solve the problem of mechanising building construction in a comprehensive way.

Five Formulae for Safer Motor Racing

Frequent formula revision and the circumstances of modern racing have created new hazards for the racing driver. Rules for servicing and inspection and a rational approach to classification could make motor racing safer.

By Brian Lister

AT 4 P.M. on 26 June the chequered finishing flag was raised signalling the end of the 28th Le Mans 24 hour motor race. This race was won by a Ferrari sports car driven by the Belgians, Oliver Gendebien and Paul Frère, and in fact Ferraris filled five of the next six places.

There is probably more controversy about Le Mans than any other motor race. It is the most important race in the whole motor racing calendar so far as the large manufacturers are concerned. The reason is that a car winning this event will be featured on the front page of almost every newspaper in the western world. Two British companies, Bentley with five pre-war wins, and Jaguar with five post-war successes, have added considerably to their prestige through winning this race. The event was also largely responsible for the present dominating position of British companies in the disc-brake field. Jaguar were the first to use discs successfully in competitions at Le Mans in 1953.

In permitting several years back prototype cars to take part in addition to production cars, the organisers allowed contestants to build what were virtually "specials" for the Le Mans race. These cars are in the Appendix C category and are really, in many instances, thinly disguised Grand Prix cars built by manufacturers who are anxious for an outright win. Typical of these was the Levegh 3 litre Mercedes. At the other end of the scale are the genuine sports cars entered by manufacturers who wish to demonstrate speed and stamina on their large-scale production models. Again typical of these was the Austin Healey of Macklin.

A 1960 sports racing car qualifying for Appendix C is the Jaguar illustrated. One of the last Appendix C sports cars to be built for Le Mans, it was built this year for the American millionaire, Briggs Cunningham. It ran well in practice but suffered a broken fuel injection pipe in the race, and later a broken piston. The second failure was obviously related to the broken pipe. It has a six cylinder engine of 2,997 c.c. developing 295 b.h.p. at 6,800 r.p.m. The weight of the complete car is 1,925 lb. Note the high windscreen called for by 1960 regulations.

The specials really got out of hand one year when Taruffi arrived with a twin-boom special, a device which admittedly had four wheels but its engine was housed on one side in one boom in line with the front and rear wheels on that side, and the driver placed directly opposite in another boom. It would be difficult to imagine a less practical sports car, yet it was made to a specification within the Appendix C regulations as they stood at that time.

Whenever designers find a way round the existing regulations a new set are drawn up by the Le Mans authorities, and normally the Fédération International Automobile, the body governing motor sport, follows suit. And so these regulations shape sports car racing for another year.

There have consequently been many changes in sports-car regulations in the past five or six years, and of course these changes have cost manufacturers vast sums of money. Just as one car is perfected and successfully raced it becomes obsolete and the firms have to begin all over again. Back in 1953 the following works teams took part at Le Mans—Cunningham, Allard, Talbot, Nash Healey, Ferrari, Jaguar, Alfa Romeo, Aston Martin, Lancia, Austin Healey, Gordini, Bristol, Borgward, Porsche, Fraser Nash, Osca, Panhard, Renault, DB, and the Spanish Pegaso. But in 1960 only Porsche, Ferrari, Triumph, Lotus, Osca, Austin Healey, Lola, Healey, DB, Abarth and Stranguellili entered works cars. The stage is now set for a return to a Le Mans where catalogue production models will be raced, and it is earnestly hoped that next year's event will be for Appendix J cars only.

The main governing rule in Appendix J is that there should be at least a hundred examples manufactured in one year of any model. This rule alone is enough to prevent any specials being entered. The speed differential should also be eased to a degree, because it is as unlikely that there will be any standard production models available capable of this year's highest registered speed—170 miles an hour by Gregory's Maserati down the Mulsanne straight.

There have been mechanical failures present in several of the recent accidents that have occurred in motor racing. Engine and transmission failures are commonplace in the sport, but they rarely lead to serious accidents, although one very nearly did. It occurred at Oulton Park in 1954. A crankshaft broke on a competing car during a race and locked up the transmission. The crankshaft came out through the side of the cylinder block and wound itself round the steering column, which it locked up solidly; it also sheared a brake pipe. The unfortunate driver thus was deprived of his steering and his front brakes, and at the same time his rear wheels were locked. This, however, was a freak situation and by far the most serious failures are those where the brakes, suspension, wheels, or steering are involved.

One of the last Appendix C sports cars to be built for Le Mans, a converted Jaguar with a high windscreen to meet the 1960 regulations.

It is failures of this kind that have been on the increase recently, and they apparently underline the "good sense" of the 1961 Grand Prix Formula which includes a weight limit. But is this limit justified? I do not think so. For one thing the overall weight limit of half a ton refers to the whole motor car. It is well known that one way to improve road holding is to improve the sprung to unsprung weight ratio. With the new formula, road-holding, power and braking are the only performance factors that can be improved. It is obvious that designers will attempt to reduce the weight of brakes, suspension, wheels and steering parts to improve the road-holding. The claim that the new formula is safer therefore is ridiculous. The failures that have occurred recently in Grand Prix racing that have come to my attention were caused by faults in detail design, or lack of adequate servicing. To rectify these design faults would mean, for example a larger radius left at the root of a component, or an extra gusset on a bracket or something of that kind.

Now if certain minimum sections were laid down for the size of stub axles, steering arms, drive shafts and so on that would be a very different matter. But then not only would the officials that control motor racing be making the rules, they would also virtually be designing part of the car and would be setting the scrutineers an impossible task of checking.

Servicing is another matter, and it should be easy for any competent manufacturer to see that his cars are serviced properly. Why then is it not done? The main reason is that the calendar is arranged in such a way that mechanics are too busy keeping up tight schedules between racing circuits on the Continent to service their cars adequately on all occasions. The lesson here is that if the FIA wish to make motor racing safer they should concentrate more on doing their own job properly by sorting out dates and location of races rather than trying to replace the designers by deciding what minimum weight a car should be.

A further useful suggestion is that there should be something like a certificate of race worthiness carried with every Grand Prix car. This should incorporate a prior to practice and prior to race inspection sheet, which has been prepared by the manufacturer, and every component should be signed for by a recognised mechanic and presented to the scrutineers prior to practice and the race.

There should also be an inspection schedule for each component after it has completed so many hours or miles of racing. It is surely not too much to expect the Royal Automobile Club in this country to organise something of this kind. It should be started immediately for Formula 1 and Formula 2 cars, and if successful should be mandatory for every car involved in motor racing.

There is no doubt that racing car manufacturers could learn much from the aircraft industry in servicing and inspection, and it is a great surprise to me that some of the manufacturers who have been closely connected with the aircraft industry in the past have not done so long ago.

It is in the interest of all racing enthusiasts to make the sport as safe as possible. It was only six years ago that the Italians had the finest drivers in the world with such champions as Ascari, Farina, Villoresi, Castelotti, Bonnetto and others. Since that time these drivers have either retired or have met their end on the racing circuits of the world. It has since been Britain's turn to lead the world with their racing motorists, but in the last two or three years we have had a similar run of accidents and retirements to those experienced by the Italians a few years back.

Motor racing should and could be a far, far safer sport.

Breeding Fast

AFTER 1980 all nuclear plants constructed in the United Kingdom may be fast breeder reactors. At the other end of the time-scale, the first electricity ever produced from nuclear fission came from a fast breeder when on December 20, 1951 the Experimental Breeder Reactor No. I of the Argonne National Laboratory produced enough power to feed the station supply. If viewed from a distance, the thermal reactor programme which now occupies most attention, will seem as a mere interlude during which the fast reactor went through its larval transitions from the early experiments to the power stations of the 1980's.

Wartime Origin, Peacefully Demonstrated

It is not surprising that fast reactors were recognised as a possibility for power production at a very early stage in the development of nuclear science. From the historic point of view thermal reactors were simply evasive measures taken to overcome the then insuperable difficulties of controlling a positive temperature coefficient and obtaining large quantities of pure fissile material. As early as 1945 experiments were begun at the Argonne National Laboratory, which led to the construction of the first Experimental Breeder Reactor. EBR-I went into operation in 1951 and was producing electricity by the end of that year. The experiment has been in operation ever since and has survived a major reactor core meltdown

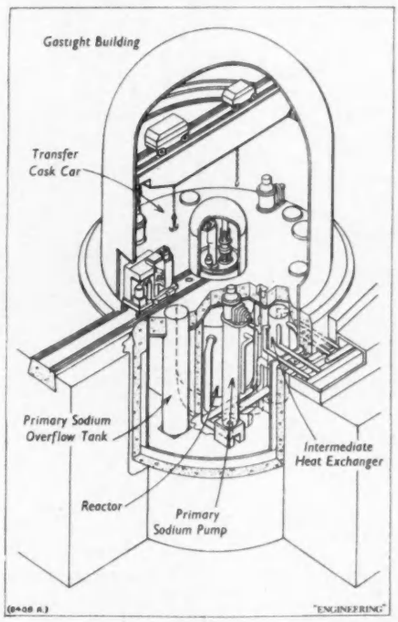


Fig. 1 Section of the Enrico Ferm station, private capital's first venture into fuel breeding.

without ending its useful life. EBR-I demonstrated that a fast breeder reactor can be operated easily and reliably by a small crew, and that it is possible to carry out major repairs on heat exchangers and primary-circuit components years after starting up the reactor.

Enter Private Capital

Favourable experience with the first prototype suggested taking less timorous steps. Private capital was to take part in a fast breeder programme for the first time, and two non-profit associations with largely duplicated membership were formed—the Power Reactor Development Company and Atomic Power Development Associates—with the aim of constructing and operating a fast-breeder power reactor, later named after Enrico Fermi. Very American in proportions, the companies forming PRDC, mostly public utilities and equipment manufacturers, have a gross equity of about $2,000 million and have put almost $50 million at the disposal of PRDC. The cost of the 100 MW station, shown in Fig. 1, is estimated at roughly $34 million, with interest charges and other expenses adding $8 million more. The operation of this reactor will require over 1,100 kg of fresh uranium 235 every year, and will consume by 1981 approximately 2,600 kg of uranium 235.

Plutonium Cycle

The Enrico Fermi reactor is not an advanced model and it will be badly out of date by the time it comes into operation. Equipped with a whole string of experimental reactors, the USAEC will have ensured its obsolescence. The Commissions's efforts are centred at Argonne and the National Reactor Testing Station. At NRTS the commission operates a transient reactor test and the fast source reactor, while the second experimental breeder reactor (EBR-2) is still under construction. At Argonne the zero-power reactors numbers 3, 6 and 9, and the low-flux thermal reactor Juggernaut are all used in various phases of the fast-reactor programme. EBR-II, shown in Fig. 2, was described at both Geneva conferences, it has been under construction since 1957 and should be completed this autumn. Although an experimental reactor, it was designed to simulate as far as possible the conditions found in a commercial station. An equally important task will be to demonstrate for the first time in the United States the operation of a fast reactor on the plutonium fuel cycle.

Molten Plutonium

One of the most attractive features of the fast reactor, at least from the engineer's point of view, is that much greater liberties can be taken in the choice of core materials than is permitted by the thermal reactor. In spite of this the operation of a fast reactor using canned fuel elements is "burn-up limited," that is its economics is tied to the life of fuel elements inside the core. The Americans have been exploring the possibilities of molten-fuel reactors in the Los Alamos LAMPRE series, the first model of which went into operation in November, 1959, and the second model is expected to become critical this year. The container is manufactured of tantalum, a material that is unfortunately a bad poison even for fast neutrons, but in the absence of fuel cans and other structural materials breeding ratios over 1·4 or 1·5 can be expected. An alternative approach is being attempted by General Electric under contract to the USAEC, in which the plutonium oxide—uranium oxide fuel cycle is used in a way that would make fuel fabrication costs sufficiently low to permit relatively frequent reprocessing.

Improved Breeding Ratio

Russia, although not involved in power station construction, is not far behind the United States in the engineering of fast reactors. According to the paper by A. I. Leipunsky and his colleagues, *Experimental Fast Reactors in the Soviet Union* (Geneva, 1958, P/2129), investigations of the prospects for the industrial use of fast reactors started in 1949. The paper describes the zero-power reactor BR-1, the low-power reactor BR-2 and the medium power prototype BR-5 which was to lead to the first industrial power station BR-50. The latter has not so far been described in any detail, but is known to be designed for plutonium. The experience of the Russians with their three reactors supports the American contention that a fast system can be operated safely and conveniently even on an industrial scale. (Fast Breeder Reactor Programme, USAEC publication TID-8523.) In addition, both the Americans and the Russians have found that the value of ν, the number of neutrons released per fission of uranium, is higher than originally assumed (D. Ocrent, Physics of Breeding Conference, October, 1959) and hence a slight improvement in the breeding ratios can be expected.

Adjunct to a Thermal Programme

The approach in France and the United Kingdom has been a little different from that followed by the Americans and Russians. Here, the fast reactor was first regarded as a supplement to a thermal reactor programme, not an alternative; it was developed in order to make the best use of plutonium produced in natural-uranium reactors. The United Kingdom fast-reactor programme started with Zeus, a uranium-fuelled zero-energy facility, but as early as 1954 the first fast reactor operating on plutonium fuel went into operation. Zephyr, as the plutonium-burner was called, operated from 1954 to 1958 when, having completed the experimental programme, it was dismantled. Dounreay, still only an experiment although capable of producing 60 MW of heat, has been in operation since early this year, but the first core loading is uranium 235, not plutonium. A prototype power-producing reactor is planned for completion by 1967, that is six years after the Enrico Fermi station comes into operation.

Value of International Exchange

In France the fast reactor programme is only now getting on its way with the construction of the Cadarache centre that will house Rapsodie, a 10 MW(t) solid-fuel fast reactor. The project is still in its preliminary stages and the ground for Rapsodie will not be broken until 1961. In the meantime several members of the Commissariat a l'Energie Atomique are attached to the Argonne Laboratories to gain experience, and Dr. S. G. Kaufmann from Argonne has been on loan to CEA since November, 1959. Prior to his assignment in France, Dr. Kaufmann was in charge of the EBR-I experimental programme at NRTS. Since the engineers of CEA are able to draw on American experience, they hope to be able to dispense with the first stage of fast reactors operating on uranium fuel, and hope to design Rapsodie directly for plutonium. Suitable fuel fabrication facilities will be erected at Cadarache capable of handling metallic or ceramic plutonium.

Experience So Far

From the international acceptance of fast breeder reactors it appears that rapid strides will be made in

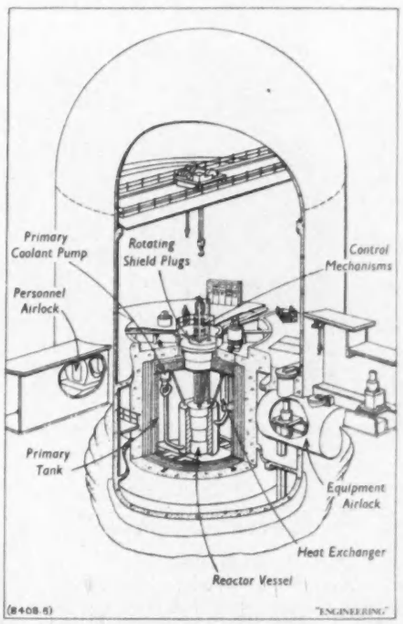


Fig. 2 Argonne's Experimental Breeder reactor No. II will utilise experience from five fast reactors.

the concept's development during the 1960's. Although most of the programmes are of an experimental nature, limited experience with the Enrico Fermi plant points to two encouraging features. The construction costs of this plant are not significantly higher than the cost of first generation thermal plants of similar size. "This is particularly significant since rather conservative performance has been assumed for the plant, but higher performance capability has been provided." (TID-8523). The second consideration is that liquid-metal cooling permits the use of steam conditions that match the performance of the most efficient conventional plants available today. Thus it may be possible to operate conventional and nuclear boilers side by side, both feeding the same set of steam turbines.

Operate on Any Cycle

The experimental programme on the other hand has shown that fast breeder reactors can be readily adapted to almost any breeding cycle conceivable:

they are thus "dual-fuel" reactors capable of operating both on plutonium and on uranium, and can take advantage of any future fluctuations in world market prices, if and when a free market is established, just as dual-fuel thermal stations do today. Flexibility is not confined to the choice of plutonium or uranium; it has been shown that pure plutonium 239 or the equilibrium mixture of plutonium isotopes produced in high-burnup thermal stations can be used interchangeably. Actually, the breeding ratio will be slightly greater on the equilibrium mixture than on plutonium 239, a fact of particular importance in view of the higher and higher burnup attained in today's thermal reactors. Finally, it has been shown that breeding in fast reactors is not a long-term proposition, but that the fuel produced can be included in the accounts during the reactor's lifetime. The fuel doubling time, allowing for reprocessing losses and an 80 per cent utilisation, is of the order of seven years, making it possible to produce three times the original fuel inventory during the plant's 25 year lifetime. In thermal breeder reactors the fuel doubling time is between 20 and 30 years unless the fuel is reprocessed at uneconomically frequent intervals.

Moderated Breeder Blanket

The main development effort in the design of fast reactors has so far been devoted to the core, around which a simple high-density breeder blanket has been placed. No attempt has been made to optimise the breeder inventory, as this forms only a small part of the total cost. But with fully optimised commercial stations it will be necessary to investigate the possibility of improving the blanket. A simple method is to mix an appropriate moderator into the blanket, by this means the blanket inventory can be reduced by a factor of 2 or more. The logical conclusion of this idea is of course the coupled fast-thermal reactor which may become the standard power producer as more experience is gained with the first prototypes.

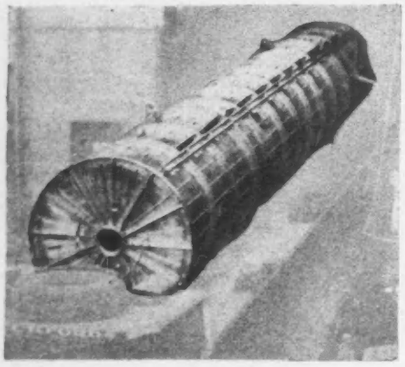


Fig. 3 (left) Radio frequency liner for Nimrod being delivered to Harwell.

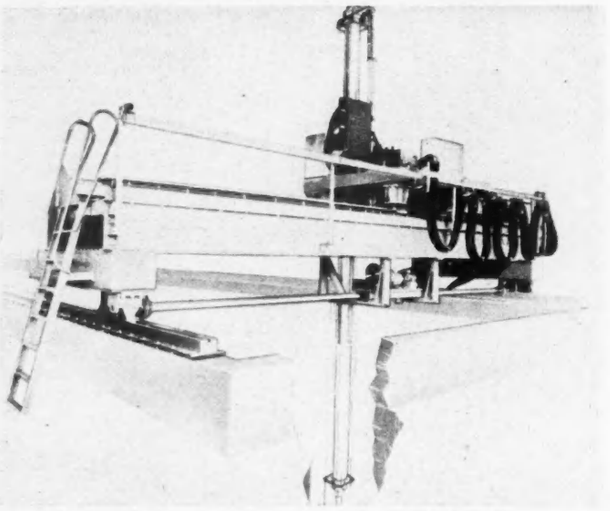


Fig. 4 (right) An automatically controlled travelling bridge crane carries the radiation instruments used in aircraft shielding experiments.

Notes and News

General Atomics Migrates to Europe

Continuing the invasion of Europe, General Atomic, Division of General Dynamics, has set up a new company with headquarters in Zurich, and branches in Milan and Düsseldorf. General Atomic Europe as the company will be known, has been created for the utilisation of the parent company's nuclear know-how inside both the Common Market and the countries of the Outer Six. The move of General Dynamics towards Europe is the latest manifestation of a long trend that was pioneered by Westinghouse, General Electric, Sylvania-Corning, and Atomics International, all of whom obtained European footholds either by extensive licensing agreements or the formation of joint companies. Allis-Chalmers, with established research connections in Italy, took the plunge into the French market by licensing Société Rateau only two weeks ago (Atomic Review, 15 July '60).

New Graphite Process Reduces Costs

Substantially reducing the time and cost of making moulded graphite, a new process has been developed by the Armour Research Foundation. The cost reductions are achieved by combining the two essential steps of graphite manufacture into one operation: the carbonisation and the graphitisation of the mixture of binder and petroleum coke. Previously the binder and coke mixture was heated to 2,700° F in moulds; allowed to cool in order to remove the moulds; and then reheated to 5,000° F to crystallise the carbon into graphite. In the new process, the mixture is heated directly to the graphitisation temperature without intermediate cooling. The process is made possible by using furfuryl alcohol—a thermosetting plastic—as binder, which eliminates the need for supporting the graphite in a mould during the carbonisation process. Thus there is no need to remove the moulds which would not withstand the graphitisation temperature, and the process can be completed in one uninterrupted step. The new process cuts the time necessary for making laboratory graphite specimens of comparable size from two weeks to two hours. Although the largest specimen produced to date by the new process is only a 1½ in square bar 4 in long, it is believed that the process can be adapted to making commercial reactor components.

Appointments at Harwell

Deputy director Dr. F. A. Vick has been appointed director, and chief chemist Dr. R. Spence has been appointed deputy director at the Harwell Establishment of the Atomic Energy Authority effective 1 September.

Liner for Nimrod's Injector

The first radio-frequency liner for the linear accelerator that will serve as injector for Harwell's 7 GeV proton synchrotron Nimrod has been completed by London Aluminium Company. Before fabrication, a full-scale mock-up of a portion of the liner had to be prepared and sent to Harwell to check the standards of workmanship and materials. The liner, shown in Fig. 3, measures over 44 ft and contains approximately 5 tons of 10 gauge high conductivity copper. A constant temperature clean-conditions shop was erected for the fabrication, which demanded an accuracy of ⅛ in in the length and 0·015 in in diameter.

Thermal Stresses in Concrete Shields

It has been shown that in a slab of concrete which is constrained to stay flat, a temperature difference of about 50° C can be allowed with only a nominal amount of reinforcement to control cracking. But if the temperature difference is greater than about 87° C, then either the steel or the concrete must be stressed beyond the usual working limits of 18,000 and 1,000 lb per sq. in respectively. Of the two alternative solutions—heavy reinforcement to prevent thermal cracking, or a steel thermal shield to eliminate the temperature gradient—the thermal shield is probably the cheaper solution. (William Bonsall: "Stresses in Reinforced Concrete Shields for Nuclear Reactors," *Proceedings* of the Institution of Civil Engineers, vol. 16, p. 259, July, 1960, paper No. 6426.)

New Gleam for GLEEP

Europe's first reactor, GLEEP, in operation for some 13 years, recently underwent extensive modifications to extend its useful life. GLEEP stands for graphite low-energy experimental pile, it is an air-cooled facility that went critical in August, 1947. The reactor operated without any major modification on the original loading of fuel for 13 years and it was felt that without an overhaul it would not be safe any longer. The fuel, 33 tons of canned uranium oxide pellets and bare metallic uranium bars, were among the first fuel elements fabricated in this country. The metallic bars had deteriorated with time and during unloading the channels were blanketed with argon to prevent the possibility of fire. Vacuum cleaners were used to remove dust and particle accumulations from the channels. The reactor has been recharged with natural uranium canned in aluminium, while the original fuel is now being reprocessed at Windscale.

Oscillator Material Testing

During the shut-down of GLEEP the reactor instrumentation was completely renewed. Most of the new instrumentation is conventional although the opportunity has been taken of fitting transistorised linear and deviation amplifiers. The reactor is used principally for material testing, making use of a device known as an oscillator. This takes small samples rapidly from the edge of the pile to the centre, and back again. The resultant fluctuation of power level is measured and the slow-neutron absorption cross-sections of different materials compared. Samples of graphite made in this country for use as a moderator in reactors of the Civil Power Programme are tested in GLEEP as well as other specimen components of reactors.

Automatic Bridge-Crane Carries Instruments

A bridge-crane with stainless-steel rails and wheels finished to 30 microinch standard will carry and position the instrument cluster used in the evaluation of aircraft reactor shielding materials at the Idaho Reactor Testing Station. The crane, shown in Fig. 4, straddles two 30 ft deep pools and carries a load of 30 tons. An automatic control system which includes an analogue-to-digital coder is used to move the instrument mast in any preselected pattern within the volume of the pools. The stainless-steel rails were necessary because of the high prevailing humidity at the water surface. The manufacturers of the instrument-bridge are General Mills, who specialise in remote handling gear.

Reactor Notes: Tenders Galore

Tenders for Brazilian Power Reactor: Kennedy and Donkin, consultants to the Brazilian Government on the construction of a 150 to 225 MW(e) power station, hope to call for international tenders around 1 October.

Tenders for Nuclear Ships: From a parliamentary exchange between Mr. Wall and Mr. Marples, it appears that the tenders for the commercial marine reactor are expected this week.

Tenders for EDF-3: Six tenders are now under study by Electricite de France for the third gas-cooled graphite-moderated power station EDF-3. Three of the tenders incorporate concrete pressure vessels.

Tenders for South African Test Reactor: Allis Chalmers won the order for a material testing reactor from the South African Atomic Energy Board. Impending placement of the order was reported in Atomic Review, 26 February this year.

Tenders for Chooz: As anticipated in Atomic Review last week, the contract for the 242 MW(e) Chooz power station of Société d'Energie Nucleaire Franco-Belge des Ardennes (SENA) has just been awarded to Westinghouse. This will be the third PWR Westinghouse is building in Europe, the others are in Italy and Belgium.

ENGINEERS
PHYSICISTS

The FIBRES DIVISION of IMPERIAL CHEMICAL INDUSTRIES LIMITED

has openings for men to work in Research Department at Harrogate as

TEXTILE ENGINEERS

These openings will appeal to applied physicists—they will also be of interest to young graduate engineers who would prefer to start their industrial career in research and development and possibly transfer to general technical management in a few years' time.

These men will become members of the existing teams which at present mainly consist of chemists and physicists working on the invention and development of new processes for making melt-spinnable synthetic fibres.

These vacancies are additional to the normal requirements for engineers in the Company.

Previous experience in the textile machinery industry is not essential—experience in the aircraft, motor car, guided missile or atomic energy industries might well enable applicants to bring new techniques to this field.

Conditions include five-day week, canteen facilities, Staff Pension Fund and Employees Profit Sharing. Assistance to married men to enable them to move into the district is available in the form of mortgage facilities, removal expenses and lodging allowances.

Write in the first instance to:—

The Personnel Manager,
IMPERIAL CHEMICAL INDUSTRIES LIMITED,
Fibres Division, Harrogate, Yorkshire,
QUOTING REFERENCE T.14/N. C612

'Engineering' Appointments Section

AIC Executive Selection Service

is advising on the following appointments

ENGINEERS (Consultants)

Associated Industrial Consultants Limited require engineers between 28 and 38 years of age for work in the United Kingdom, British Commonwealth and Europe. A University degree or equivalent qualification is essential. In addition, experience of at least five years in a managerial capacity is required. Selected applicants will be trained at the Company's College of Management and the posts carry an initial salary, according to qualifications, of approximately £1700-£2100 per annum with opportunity for regular increases to £2700. In addition there are superannuation contributions and expense reimbursements by the Company and opportunities for promotion to senior positions with considerable advancement in salary. Special consideration will be given to those wishing to reside in Ireland and Scotland, and to those who are fluent in French, Dutch, German or Italian.

Brief written applications should be sent, in complete confidence, to

Personnel Secretary (422/2) at

Associated Industrial Consultants, Limited,

BUSH HOUSE, LONDON, W.C.2

Associated Industrial Consultants

C 667

PUBLIC APPOINTMENTS

B. S. R. A.

THE BRITISH SHIPBUILDING RESEARCH ASSOCIATION has vacancies in the following two Grades in its MARINE ENGINEERING SECTION:—

(*a*) GRADE B—This Grade includes persons who have been assessed as having the ability to initiate, lead and execute research. Qualifications required are a good University Degree in marine or mechanical engineering and with practical training and experience. Research experience and/or service at sea an advantage. The salary will be within the range of £800-£1600 per annum.

(*b*) GRADE C—The staff in this Grade are concerned with the conduct of the experimental side of investigations. Qualifications required are a Degree in marine or mechanical engineering, Higher National Certificate or equivalent qualifications. Apprenticeship or practical experience in engineering. Research and/or seagoing experience an advantage. The salary will be within the range of £725-£1350 per annum.

The commencing salary for each appointment will however depend upon age and qualifications. All appointments are subject to the Federated Superannuation System for Universities.

Applications with full particulars should be addressed to B.S.R.A., 5, CHESTERFIELD GARDENS, CURZON STREET, LONDON, W.1. C 657

POST OFFICE

POST OFFICE: (*a*) ASSISTANT ENGINEER (at least 15 posts for men), (*b*) TELECOMMUNICATIONS TRAFFIC SUPERINTENDENT (about 15 posts for men and women). All pensionable. Age on 1.9.60: 17½ and under 23½ for (*a*), 24½ for (*b*); with extension for Forces service, Overseas Civil Service, and (up to two years) established civil service. Duties: (*a*) technical design and development of telecommunications equipment, (*b*) planning and management of telephone services. Qualifications for (*a*) and (*b*): G.C.E. (or equivalent) in English Language and 4 other subjects, including 2 at A level obtained at same examination from Pure Mathematics, Applied Mathematics, Pure and Applied Mathematics, Physics, Chemistry. Selection by interview. Salary (London, men): (*a*) £560 at 18, 19, 20, £620 at 21, £785 at 25 or over, rising to £1205; (*b*) £597 10s. at 18, £635 at 21, £765 at 25 or over, rising to £1140. Promotion prospects.—Write CIVIL SERVICE COMMISSION, BURLINGTON GARDENS, LONDON, W.1, for application forms, quoting (*a*) 291/60, (*b*) 303/60. Closing date 12th SEPTEMBER, 1960. C 670

CIVIL ENGINEERS

MINISTRY OF TRANSPORT: CIVIL ENGINEERS. Pensionable posts for men and women at least 25 and under 35 on 1.1.60 (extension for regular Forces service, Overseas Civil Service, established civil service, and temporary Government service as Civil Engineer). Candidates must have achieved Corporate Membership of Institution of Civil Engineers or passed examinations necessary for attaining such membership. Experience in road and bridge construction essential; knowledge of Highways Authorities' procedure desirable. Salary (men, London) £830-£1125 according to age, rising to £1300. Promotion prospects.—Write CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1, for application form quoting **S 64.** C 671

GOVERNMENT OF KENYA

INSPECTOR OF FACTORIES (male, aged 25-35) required to undertake inspection duties under general direction of Chief Inspector of Factories; B.Sc.(Eng.) degree or equivalent (e.g. A.M.I.Mech.E.) and industrial experience essential. Previous experience of factory inspection or of work as safety officer in large industrial concern desirable. Post permanent and pensionable. Salary scale £939 to £1863 inclusive. Outfit and separation allowances. Quarters provided, if available, at low rental. Free passages. Generous home leave. Tour 24-45 months. Low Income Tax.—Further particulars and application forms from DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, GREAT SMITH STREET, LONDON, S.W.1, quoting BCD 132/7/01/D5. CANDIDATES SHOULD STATE THEIR FULL NAMES ON APPLYING. C 662

FOURAH BAY COLLEGE
THE UNIVERSITY COLLEGE OF SIERRA LEONE

Applications are invited for LECTURESHIP IN ENGINEERING from graduates in Civil or Mechanical or Electrical Engineering. Salary scale: £965 by £50 to £1415; £1490 by £75 to £1790 p.a., entry point according to qualifications and experience. F.S.S.U. Outfit and family allowances (maximum £300). Passages on appointment, annual leave and normal termination. Part-furnished accommodation at reasonable rent.

Detailed applications (6 copies) naming 3 referees by 15 SEPTEMBER, 1960, to SECRETARY, INTER-UNIVERSITY COUNCIL FOR HIGHER EDUCATION OVERSEAS, 29 WOBURN SQUARE, LONDON, W.C.1, from whom further particulars may be obtained. C 682

ENGINEERING ASSISTANT

£1400 p.a. is the minimum a graduate with an engineering degree (mechanical preferred) is expected to command if he has the qualifications and experience we are seeking. The successful candidate will have supervisory experience over technical staff and some experience of process electronic instrumentation. Experience of mechanical/electronic development work is preferred. A theoretic knowledge of electronics near degree standard and knowledge of electrical engineering, pneumatic control systems and drawing office practice is desirable. He will be based in London and assist the Chief Engineer in the protection and maintenance of all grounds, buildings, plant and services used by the Company. His responsibilities will include the design and procurement and installation of machinery and ancillary equipment in our factories.

Applications, giving full details of experience, qualifications and present salary should be sent in confidence to PERSONNEL MANAGER, BOX C 663, Offices of ENGINEERING.

Senior Development Engineers

A major company is seeking two experienced senior development engineers for interesting work on advanced techniques in industrial weighing.

1. University graduate, or candidate, with H.N.C. and appropriate distinctions, is required with experience in electronics, particularly in the design of circuits for servo systems and amplifiers.
2. A man with experience in investigating the problems related to electro-mechanical systems and who possesses a university degree or H.N.C. with appropriate distinctions is required. Suitable industrial experience in this field is essential.

These are both new appointments and the prospects for extended responsibility are excellent.

Write in confidence, with full details of experience and qualifications, to:—

Works Director:

W. & T. AVERY, LIMITED, BIRMINGHAM

C 631

AIR PRODUCTS (G.B.) LTD.

Suppliers of

CHEMICAL PROCESS PLANT and INDUSTRIAL GAS to

The Government, the Steel, Chemical, Gas and Allied Industries

have now embarked on a

£2M CAPITAL EXPANSION PROGRAMME

As a result, vacancies now exist for both SENIOR and JUNIOR appointments in our Engineering Department, located in the West End of London.

If therefore you are a well-qualified and/or experienced

CHEMICAL ENGINEER,
MECHANICAL ENGINEER or DRAUGHTSMAN

we invite you to apply for a permanent position with our Company.

Interviews will be arranged at any time to suit applicant's convenience.

Please write or phone
Personnel Manager
AIR PRODUCTS (G.B.) LIMITED
49/50 Poland Street, London, W.1. GER 0616
Applications will be treated with strictest confidence. C 692

B. S. R. A.

THE BRITISH SHIPBUILDING RESEARCH ASSOCIATION has vacancies in its Naval Architecture Section for persons with ability to initiate, lead and execute research. For this post the applicants should have an honours degree in naval architecture. The ceiling of salary is £1600 per annum and the commencing salary will depend upon age and qualifications. There are opportunities of promotion above this ceiling to a higher grade.

In addition to the investigations which the research staff themselves conduct, including work on board ships, they are also engaged upon progressing a programme of researches carried out under contract at outside laboratories, Government research establishments, Universities, etc. Members of the staff also deal with the technical secretarial work of the Association's system of research committees. All positions carry superannuation.

Applications with full particulars of education, apprenticeship, practical training and research experience should be addressed to B.S.R.A., 5 CHESTERFIELD GARDENS, CURZON STREET, LONDON, W.1. C 680

DERBY AND DISTRICT COLLEGE OF TECHNOLOGY

Principal: T. HEAP, Ph.D., M.Sc., F.R.I.C., A.M.B.I.M.

DEPARTMENT OF MECHANICAL ENGINEERING

Applications are invited for the following posts, duties to begin in September, 1960, or as soon as possible afterwards:—

(*a*) SENIOR LECTURER IN MECHANICAL ENGINEERING, to specialise in teaching Strength of Materials and modern methods of Materials Testing. He will, however, be required to teach other subjects also up to Engineering Degree and Higher National Diploma standard. Applicants should have an honours degree and good industrial and teaching experience.

(*b*) ASSISTANT (Grade B or A, according to qualifications and experience) to teach the subjects of science and technology to students in Machine Shop Engineering and Foundry Courses. Applicants should have good industrial experience and appropriate academic qualifications.

Salary in accordance with the 1959 Burnham Scales:—

Senior Lecturer—£1550 by £50 to £1750.
Assistant Grade B—£700 by £27 10s. to £1150.
Assistant Grade A—£520 by £27 10s. to £1000.

On the scales for Assistant Grade A and Grade B, allowances are made for degree and training and up to 12 increments may be given for approved industrial experience.

Application forms, returnable by 20th AUGUST, and further details can be obtained from the REGISTRAR, DERBY AND DISTRICT COLLEGE OF TECHNOLOGY, KEDLESTON ROAD, DERBY. C 681

DESIGNER DRAUGHTSMEN

AIR MINISTRY, Works Designs Branch, requires in LONDON, STRUCTURAL ENGINEERING DESIGNER DRAUGHTSMEN for reinforced concrete or structural steelwork of all types. Applicants must have adequate training and several years' experience. Some site experience and possession of recognised technical qualification an advantage. Financial assistance and time off may be allowed for recognised courses of study. Promotion and pension prospects. Five-day week with 18 days paid leave per year initially. Salary ranges from £680 (at age 25) to £900 p.a. Commencing salary dependent on age, quals, and exp. Applicants, who must be natural born British subjects, should write to AIR MINISTRY, W.G.d., LACON HOUSE, THEOBALDS ROAD, LONDON, W.C.1, or apply to any Employment Exchange quoting Kings Cross 3745, giving age, details of training, quals., full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. G 888

B. S. R. A.

THE BRITISH SHIPBUILDING RESEARCH ASSOCIATION has vacancies in its ATOMIC ENERGY SECTION for men aged about 25 with a good University Degree in marine or mechanical engineering and with practical training and experience. Research experience an advantage. The persons appointed will be required in the first instance to work in the Association's team at Winfrith, Dorset, studying the possible application of nuclear power to merchant ship propulsion. Experience of nuclear energy is not an essential qualification as training in this will be given. The commencing salaries will depend upon age and qualifications and the appointments are subject to the Federated Superannuation System for Universities.

Applications, with full particulars, should be addressed to: B.S.R.A., 5, CHESTERFIELD GARDENS, CURZON STREET, LONDON, W.1, quoting reference JER. C 656

QUANTITY SURVEYORS AND ASSISTANT QUANTITY SURVEYORS

required by:—
ADMIRALTY
WAR DEPARTMENT
AIR MINISTRY
MINISTRY OF WORKS
MINISTRY OF EDUCATION

Vacancies in London, Provinces and occasionally overseas. London salaries for suitably qualified and experienced men over 25 years of age range from £830-£1300 p.a. QUANTITY SURVEYING ASSISTANTS and others having some experience in Quantity Surveying at salaries ranging from £387 10s. 0d.-£900 p.a. also required. Prospects of promotion and pensionable status.—Write for particulars of vacancies in each Department and forms quoting JQS to MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (ROOM 403), 26, KING STREET, LONDON, S.W.1. C 694

MIDDLESEX COUNTY COUNCIL EDUCATION COMMITTEE HENDON TECHNICAL COLLEGE THE BURROUGHS, HENDON, N.W.4

Applications are invited for the following posts. Duties to commence as soon as possible and in any case not later than 1st January, 1961.

MECHANICAL ENGINEERING DEPARTMENT

PRINCIPAL LECTURER to teach one or more Mechanical Engineering subjects to post Higher National Diploma Standard. Candidates should be honours graduates and corporate members of the Institution of Mechanical Engineers.

SENIOR LECTURER to teach Theory of Machines to Higher National Diploma Standard. Candidates should be graduates and corporate members of the Institution of Mechanical Engineers.

LECTURER to teach one or more Mechanical Engineering subjects to Higher National Certificate Standard.

ASSISTANT GRADE B to teach one or more Mechanical Engineering subjects to Ordinary National Certificate Standard.

Candidates for these two posts should be graduates and/or corporate members of the Institution of Mechanical Engineers.

Salary within the range (men):—
Principal Lecturer, £1788-£1951 per annum.
Senior Lecturer, £1588-£1801 per annum.
Lecturer, £1408-£1601 per annum.
Assistant Grade B (graduate), £828-£1486 per annum.

Application forms and further deatils (s.a.e.) from the CLERK TO THE GOVERNING BODY, TOWN HALL, HENDON, N.W.4, to whom completed forms must be returned within two weeks from the date of appearance of this anvertisement

C. E. GURR, M.Sc., Ph.D.,
SECRETARY TO THE EDUCATION COMMITTEE, C 686

HEAD WRIGHTSON & CO. LTD.

RESEARCH AND DEVELOPMENT DEPARTMENT

require

MECHANICAL ENGINEERS

for senior positions

Applications are invited from UNIVERSITY GRADUATES who have had several years practical experience, preferably in the design of plant for the heavy industries.

These positions offer considerable scope for advancement for the successful candidates, who would join a team responsible for design and development of new projects in a wide range of interest.

Staff Pension and Life Assurance Scheme. Assistance with house purchase.

Write giving details of age, experience, qualifications and salary range to:—

THE PERSONNEL MANAGER,
REF. RD/45,
TEESDALE IRON WORKS,
THORNABY-ON-TEES C 691

RESEARCH ENGINEER

THE PARSONS AND MARINE ENGINEERING TURBINE RESEARCH AND DEVELOPMENT ASSOCIATION requires a Research Engineer of degree standard to work on an extensive programme of aerodynamic research in connection with steam and gas turbines. A man of the highest possible standard with some experience of aerodynamics and a strong mathematical background is preferred and a suitable salary will be offered.

Apply in writing to the

DIRECTOR,
PAMETRADA RESEARCH STATION,
WALLSEND,
NORTHUMBERLAND

C 689

TECHNICAL DIRECTOR

TECHNICAL DIRECTOR is required by a progressive medium sized general engineering Company in Glasgow. Applicants, who should have a civil or mechanical engineering degree and proven success, must be fully capable of taking complete charge of the technical departments involving Design, Research and Development and Drawing Office, new plant, etc., and should have had a good experience of works practice and modern techniques involved in welded fabrication units.

Corporate membership of a senior engineering institution would be an advantage to the candidates.

Candidates should be in the age range of 35/45. The post which carries a salary of £2000/£3000 according to experience, is a progressive one and there are pension, life assurance and personal accident schemes.

The work will be varied and interesting involving a wide range of products, including new products requiring urgent development and every encouragement will be given to man with competence, drive and enthusiasm. Foreign travel will be necessary from time to time.

Full details, which must include age, education, qualifications, previous and present posts and stating present salary to Managing Director, BOX C 625, Offices of ENGINEERING. These will be treated in complete confidence.

GENERAL MANAGER — INDIA

(Engineering Works)

The associated company in India of a famous British Company requires a General Manager to take charge of a newly acquired engineering works near Calcutta which is to be modernised and extended for the production of various machine castings and forgings, for railway wagons, cranes, mining equipment, etc. The General Manager will be responsible for all activities including product design and drawings, manufacturing methods, production programmes, costings, labour relations and Trade Union negotiations.

Candidates, who should preferably be qualified mechanical and/or electrical engineers, aged under 50, must have had previous works management experience in the foundry, forging, and machine shop field. Salary is the equivalent of £4500 p.a. and this would be tax exempted for a period of 2/3 years for approved non-residents. Free accommodation and car provided.

This post offers great opportunity to an able and energetic manager who is also an experienced production engineer. *Reference Number* 91

Please reply in confidence, quoting reference number, to :

Robert Clive (Consultants) Limited

Appointments Consultants

27, ALBEMARLE STREET, LONDON, W.1

C 660

RALEIGH INDUSTRIES LIMITED

have a vacancy for a

JUNIOR TECHNICIAN

to construct rigs, perform Product Tests and to write reports on same. Opportunity exists to gain experience in strain gauge and vibration work using electronic equipment.

Applicant should possess an Ordinary National Certificate and be studying for the Higher National Certificate. Technical ability to use Hand Tools and to be able to construct simple rigs and electro-mechanical devices is essential. Some knowledge of Electronic/Radio circuits would be useful.

Salary according to qualifications and experience. Conditions, prospects, and opportunities are good; the post is permanent and pensionable.

Apply, giving details of age, experience, qualifications and quoting EG/M to the WORKS PERSONNEL MANAGER, FARADAY ROAD, NOTTINGHAM.

C 668

JOSEPH LUCAS LIMITED

have a vacancy for an

ENGINEER

to work in the Semiconductor Engineering Laboratory situated at

MERE GREEN, SUTTON COLDFIELD

on glass and ceramic seals and joining aspects in the development and manufacture of a wide range of semiconductor devices.

Applications are invited from candidates with a B.Sc. degree, or equivalent qualifications, and preferably with previous experience in one of the fields quoted.

The appointment, which offers opportunity for the exercise of initiative and original work in a rapidly expanding Laboratory, is permanent and pensionable.

Apply in writing, stating age, and full details of qualifications and experience to the:

Personnel Manager,
JOSEPH LUCAS LIMITED
Great King Street, Birmingham, 19
quoting reference PM/MG/479

C 655

ASSISTANT INSTRUMENT ENGINEER
ASSISTANT ELECTRICAL ENGINEER
AND
ASSISTANT MECHANICAL ENGINEER

are required by the

UNITED KINGDOM ATOMIC ENERGY AUTHORITY AT WINDSCALE AND CALDER WORKS, CUMBERLAND

The Instruments and Electrical posts are associated with the new "Advanced Gas Cooled Reactor," now being built at Windscale, which will be operated at higher temperatures and ratings and is the experimental prototype for the next generation of nuclear power stations.

The duties of the Assistant Instrument Engineer will be to assist in the commissioning and maintenance of particle and radiation detectors, data loggers, closed circuit television, auto-control as well as pressure, temperature and flow measuring devices. This is an excellent opportunity for an engineer or physicist with experience in one or more of these fields to broaden his knowledge.

The Assistant Electrical Engineer will assist in a section providing an engineering service to the reactor, its associated auxiliaries and generating plant. A desire to work on the problems associated with a prototype reactor is an essential requirement.

The Mechanical Post will be to assist in the maintenance of mechanical equipment associated with Calder Hall Nuclear Power Station. This will include responsibility under a Mechanical Engineer, for the maintenance of sections of the plant, and for special investigations.

Applicants must have served a recognised engineering apprenticeship, pupilage, or have had comparable training, and be at least graduate members of an appropriate senior engineering institution, or equivalent.

Salary according to qualifications and experience within the scale £860 at age 25 to £1340 p.a.

Contributory Superannuation. Staff Housing Scheme.

Send postcard for application form, quoting reference P/W 34/J2, to Recruitment Officer, U.K.A.E.A., Production Group, Windscale Works, Seilafield, Seascale, Cumberland.

Closing Date: 15th August, 1960

C 659

FULLY QUALIFIED AND EXPERIENCED

WORKS ENGINEER

required by large, leading food company, with processes of a fully-automatic nature, near London. Successful applicant will—

—control an engineering department responsible for: repair and maintenance of all mechanical and electrical equipment; installation of new equipment; building maintenance; power plant and machine shop.

—be able to demonstrate that he has successfully undertaken similar responsibilities in a similar type of Company.

—have proved himself in the administration of an engineering department, and the control of men.

—be a Chartered Engineer with appropriate qualifications which, ideally, will include a University degree in Engineering.

—be between 30 and 40 years of age.

Good commencing salary, progressive salary grade, excellent fringe benefits, and considerable scope, offered to first-class man of ability and potential in line with the requirements of an expanding organisation.

Applications stating age, educational background, qualifications, experience, present position and salary, in strict confidence to BOX C 696, Offices of ENGINEERING.

DEVELOPMENT ENGINEER

Applications for the post of Senior Development Engineer are invited from chartered Mechanical or Civil Engineers, preferably experienced in High Vacuum metallurgy and design work. The advertising Company is engaged in developing vacuum furnace and high vacuum equipment activities, and the post will involve both the approval of specifications and estimates for equipment and the control of production for subsequent contracts. An ability to apply modern production techniques is therefore necessary. This new appointment by an expanding and progressive engineering concern, will be located in Lancashire; it will command a good salary.

Applications must detail age, education, academic qualifications, experience, and should be addressed to:—

Ref. 455,
The Wallace Attwood Company,
Chantrey House,
Eccleston Street,
London, S.W.1,

who are acting on behalf of the Company in the first instance. C 654

APPLEBY-FRODINGHAM STEEL COMPANY

SCUNTHORPE, LINCOLNSHIRE

invite applications for

SENIOR DESIGNERS

also

SENIOR & JUNIOR DRAUGHTSMEN

for general engineering work

Experience with plant for Iron and Steelworks would be an advantage but is not essential.

Permanent situations with good prospects of advancement for men with initiative and ability.

Staff Pension Scheme, welfare and sports facilities are available.

Apply, giving age, full particulars of previous experience and technical qualifications to the CHIEF ENGINEER. C 633

QUALITY MANAGER

Applications are invited immediately from experienced QUALITY ENGINEERS for the post of QUALITY MANAGER in a mass-production light engineering firm in the Glasgow area.

The Quality Manager will be responsible for the maintenance of quality throughout the works, and for the quality of large quantities of bought-out parts.

Suitable qualifications would include all or most of the following: (i) An engineering apprenticeship followed by at least five years' experience in a light engineering industry; (ii) Five to ten years' experience as a quality engineer or Manager in a large organisation, with experience in handling staff; (iii) An engineering degree or equivalent; (iv) Associate membership of the Institution of Mechanical and/or Production Engineers.

Experience and personality, plus the ability to make correct decisions and to implement same quickly, are essential requirements.

This is a Senior Staff appointment, and will carry a good four-figure salary, depending upon the calibre of the person appointed. Applications which will be treated in strict confidence, should give details of age, experience in chronological order, and present position and salary.

BOX C 658, Offices of ENGINEERING.

DESIGN AND CHEMICAL PLANT LAYOUT DRAUGHTSMEN

DESIGN AND CHEMICAL PLANT LAYOUT DRAUGHTSMEN required, Structural Steelwork or Instrument Installation experience an advantage. Permanent positions and good salaries for men with above experience. Superannuation and Life Insurance Scheme. Canteen facilities.—Apply in writing, giving full details of past experience, and salary required to: NORDAC LIMITED, UXBRIDGE, MIDDLESEX. A Member of the Woodall-Duckham Group of Companies. C 664

SALES MANAGER

SALES MANAGER required to commence duties 1st January, 1961. Age 35/40. Must have previous experience in sales promotion of air treatment plant in all its aspects. Permanent position with good prospects. Location: Greater London area.

Write: BOX C 684, Offices of ENGINEERING.

APPOINTMENTS OPEN

ENGINEERS

ENGINEERS (TWO) one having specialist knowledge air filtration, other specialist knowledge dust recovery, for design and sales from enquiry to contract completion. Permanent positions, good prospects.—Write THE VISCO ENGINEERING CO., LTD., 161, STAFFORD ROAD, CROYDON, SURREY. C 669

ENGINEER

B.B.C. requires ENGINEER, Building Department, to arrange and supervise contracts for installation and maintenance of lifts, maintenance of boiler, heating and ventilation services, refrigeration plant, gas services, etc., in the London area. Work includes liaison duties with Departments concerned with the day-to-day operation and upkeep of plant and services. Applicants, aged 35/45, should have commenced their careers with a mechanical engineering apprenticeship, preferably in heavy electrical industry, and have had considerable experience as a works engineer dealing with operation and maintenance of all building services. Salary scale £1230 to £1580 p.a.—Write for application form to ENGINEERING RECRUITMENT OFFICER, BROADCASTING HOUSE, LONDON, W.1, quoting Ref. 60.E.106.Engg. C 672

MARINE ENGINEER

FOREIGN GOING SEA APPOINTMENT

Vacancy occurs for the post of CHIEF ENGINEER in a 350 ton Auxiliary Sailing Schooner Yacht fitted with Diesel, Electrical and Refrigeration machinery. World cruising is intended.—Apply BOX C 685, Offices of ENGINEERING.

ASSISTANT RESEARCH MANAGER

ASSISTANT RESEARCH MANAGER required for a large firm of precision engineers in the Midlands. Applicants should have had sound training and experience as mechanical engineers, age 30-40, and have a good engineering degree or its equivalent. Excellent pension scheme in operation. Salary according to experience.—Apply with full information to BOX C 679, Offices of ENGINEERING.

SENIOR DRAUGHTSMAN

ENFIELD-STANDARD POWER CABLES, LTD. Contracts Department Drawing Office require SENIOR DRAUGHTSMAN, based Brimsdown (Enfield, Middlesex), experienced Preliminary Planning and Layout Cable Routes and Cable Racking Systems.—Apply (full details) to: CHIEF INSTALLATIONS ENGINEER, CONTRACTS DEPARTMENT, STOCKINGSWATER LANE, BRIMSDOWN. C 678

ASSISTANT DESIGNER

Applications are invited for a post as ASSISTANT DESIGNER for work on Steam Turbines, Centrifugal Blowers and Compressors and allied equipment. Applicants should be about 25 years of age and possess University Degree, H.N.C. or equivalent in Mechanical Engineering, and should preferably have had some practical experience. Salary according to qualifications and experience.—Write, giving particulars, to D. ADAMSON & CO., ENGINEERS, DUKINFIELD, CHESHIRE. C 677

SENIOR MECHANICAL ENGINEERING DRAUGHTSMEN

SENIOR MECHANICAL ENGINEERING DRAUGHTSMEN required for interesting work on large chemical plant installations. Experience in this type of work is desirable but not essential and applicants with general mechanical engineering experience will be favourably considered. The posts offer opportunities and salaries consistent with experience and ability. Modern offices situated in the London E.C.4 area. Five-day week and superannuation scheme.—Applications, which will be treated in the strictest confidence, giving details of age, qualifications and experience and quoting REF. LCL/E1/55, should be addressed to THE GROUP PERSONNEL MANAGER, LAPORTE INDUSTRIES LIMITED, HANOVER HOUSE, 14 HANOVER SQUARE, LONDON, W.1. C 674

TECHNICAL ASSISTANT

TECHNICAL ASSISTANT required for Development Work in connection with motor vehicle fuel systems. O.N.C. level essential together with some design drawing experience. Knowledge of hydraulics and engine testing desirable. Written applications should be addressed to PERSONNEL MANAGER, SIMMS MOTOR UNITS, LTD., EAST FINCHLEY, LONDON, N.2. C 661

ELECTRICAL ENGINEER

ENFIELD-STANDARD POWER CABLES LTD. Contracts Department require a qualified Electrical Engineer to plan systems and layouts of Power and Control Cables associated with major industrial installations and to commission the circuits after installation.—Apply to CONTRACTS MANAGER, BRIMSDOWN, MIDDLESEX. C 687

SENIOR AND JUNIOR ELECTRICAL DRAUGHTSMAN

ENFIELD-STANDARD POWER CABLES LTD. Contracts Department require a Senior and a Junior Electrical Draughtsman for work associated with the layout of Power and Control Cables associated with major industrial installations.—Apply to CONTRACTS MANAGER, BRIMSDOWN, MIDDLESEX. C 688

LAPORTE CHEMICALS LIMITED

WARRINGTON

require an ASSISTANT MECHANICAL ENGINEER for chemical plant maintenance work. Age between 25-30 years. Minimum qualifications: H.N.C. in Mechanical Engineering and some experience in the maintenance of chemical plant an advantage. A good salary will be paid commensurate with age and experience. A Pensions Scheme is in operation. Canteen facilities.

Replies, giving details of age, qualifications and experience, and quoting Ref. LCW/E1/57, should be addressed to the GROUP PERSONNEL MANAGER, LAPORTE INDUSTRIES LIMITED, HANOVER HOUSE, 41, HANOVER SQUARE, LONDON, W.1. C 690

TECHNICAL AUTHOR

TECHNICAL AUTHOR required, not over 45, to assume responsibility for the compilation of operating and maintenance instruction manuals dealing with the Company's machinery. This interesting and progressive pensionable staff position would appeal to a suitably qualified Mechanical Engineer with a bias towards technical writing.—Applications should be addressed to the PERSONNEL MANAGER, MOLINS MACHINE CO., LTD., EVELYN STREET, LONDON, S.E.8. C 693

ADVERTISEMENT RATES

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Companies

Secrecy . . . team work . . . Overseas Contracts

BACK in 1814 George Courtauld, the father of the founder of the great, diverse concern COURTAULDS Limited, held a patent for an improved spindle. And right through the expanding history of the firm successful engineering enterprise has been at the root of its progress.

Once the company had moved into man-made fibres, the demands made on its engineers sharply increased.

In addition to the new problems to be solved it was important, for commercial reasons, that secrecy should be observed. This led not only to the manufacture of the machinery by Courtaulds themselves but to the design of the works to house the plant and from there to the complete factory design.

Civil, mechanical and electrical engineers, with architects, surveyors and instrument and control specialists, are all numbered in the Courtauld team, a group, it was realised, quite strong enough to tackle outside projects. The work now undertaken for process industries outside the group is world wide and includes the design, manufacture and supply of fibre and chemical manufacturing plant for the Soviet authorities and for Yugoslavia.

For many companies the size of the issued capital is an inaccurate guide to growth since a great part of the total may have been direct investment by the public. With Courtaulds this is not the case. Of immigrant Huguenot stock, Samuel Courtauld set up as a throwster, at Bocking, in Essex, in 1816 and the Courtauld enterprise was under way.

In 1904 its issued capital was £400,000; made up of 200,000 in £1 Ordinary shares and £200,000 £1 Preference. By 1924 this had become £12 million Ordinary and £8 million Preference. After the purchase of PINCHIN JOHNSON AND ASSOCIATES, the paint group, the current Issued Capital has been raised to £78,871,395 Ordinary and £17,512,500 Preference stock.

And none of this has been raised from the shareholders or from the market.

In his annual report, the chairman, Sir John Hanbury-Williams, records that the group profits, £21,044,043, were the highest yet reached. While the textile interests account for 70 per cent of the group's assets, textile activities proved 60 per cent of the profits.

While diversification has been a deliberate and skilfully controlled development for Courtauld, its history can be traced as a straightforward and natural growth. The company's first man-made fibre was bright viscose rayon filament. Cellulose acetate fibre production was started in 1920 and developed in conjunction with BRITISH CELANESE, which was bought into the Courtauld group two years ago.

By the early 1930s growing knowledge of viscose had led to its use for transparent films to be used in packaging. Jointly with the French concern LA CELLOPHANE, the subsidiary BRITISH CELLOPHANE was formed and is now one of the major Cellophane packaging producers in the world. Only this year the group acquired DONALDSON AND FILER, of Glasgow, to broaden its interests in the use of Cellophane. Donaldson are primarily concerned with making fine fluted paper for the packaging of biscuits and confectionery.

From the earliest days of cellulose acetate development the group was active in improving moulding powders for plastics production. This led to the purchase of NATIONAL PLASTICS Limited who produce plastics products principally for the motor and domestic appliance industries.

Whether in natural or man-made materials, the textile business requires expert knowledge of dyeing, pigment application and printing. Printing on fabrics, plastics, films, metals and other materials a great deal of special experience was acquired within the group. But many kinds of paint were being brought in from outside.

So the paint industry became of double interest. First in 1958 the small but significant company, CELLON, was bought, then in the financial year under review, the influential group led by Pinchin Johnson and Associates was added to the group.

And there for the moment the pattern is allowed to rest. How long before a new element is woven into the Courtauld carpet it is not possible to forecast. The answer may as well lay in its own research laboratories as in the developments of company requirements.

Seeing the great trading advantages that accrue to those working within a large market, such as the European Common Market is in process of becoming, Sir John Hanbury Williams, hopes that Great Britain will be much more closely associated with all the European states, the Six and the Seven.

The Cost of Keeping Ahead in Steel

Three figures given by Lord Ridley, the CONSETT IRON Company chairman, in his annual report well illustrate the recovery of the steel makers. They are the last three trading surpluses taken in six month periods—£1,359,413 in the six months up to the end of March, 1959, £1,431,544 to the end of September, 1959, and £2,607,680 to March of this year.

Looking ahead, Lord Ridley sees the prospects for the steel industry staying very good, at least for the next six months. And since the decline in orders from the shipyards has been more than compensated by other demand for plates this forecast appears well on the safe side.

A quarter of Consett's ingot production is being rolled into light products at the company's Jarrow mill and it is planned to increase the volume of ingots and the range of output from the mill. Competition as tough as almost anywhere else in heavy engineering is found in the fabricated steel sector and Consett at one time was finding orders difficult to come by. Now the prospects seem brighter.

Of £7½ million spent during the year on new plant almost £7 million went on the new plate mill. Progress is up to schedule and the new mill is expected to be particularly able to work to the detailed needs of highly specialised customers. The new foundry came into operation in June of last year. The greater part of its output is used in the melting shop giving a valuable cut in steel costs.

Further useful cost cutting was achieved in the replacement of the works locomotives by diesels instead of steam. The new steelmaking plant has now been substantially ordered. The LD process is to be used for the usual range of steels and Kaldo for the types. Steelmaking in the new plant should begin by the end of next year.

Former Swiss Leader a Lansing Director

LANSING BAGNALL, the materials handling equipment makers, have appointed Dr. Karl Kobelt, the former President of Switzerland, a director of their two subsidiaries in Switzerland. The company has a record of vigorous expansion in exports and is embarking on fresh efforts in the European market.

The two Swiss subsidiaries are LANSING BAGNALL HOLDING and LANSING BAGNALL AG.

An engineering graduate of the Zurich

Federal Institute of Technology, and a doctor of engineering, the 68-year-old Dr. Kobelt (inset) was the chief of the St. Gallen cantonal government's building department from 1933 to 1940. He entered the Swiss parliament in 1939.

A member of the Government from 1940 until 1954, he held the presidential chair from 1946 to 1952.

Lansing Bagnall, the largest European makers of electric industrial trucks is exporting this year at double the rate of 1959, and accelerating the pace.

A second company announcement related to British interest in Switzerland as the European Free Trade Area increases its effect comes from WOLF ELECTRIC TOOLS. The Swiss electronics engineer, Mr. Hans Mader, is to be the Wolf sales supervisor in his own country, which was one of the first to become a foreign market for Wolf tools.

Sharp Profitability Increase in Chemicals

Modernisation catches up with the most traditional of products, often producing surprising changes. For some time modernisation schemes have been in hand by Fullers' Earth Union and they have now been carried through, with economies in production costs and with reductions in prices.

Fullers' Earth Union produces the Fulbond foundry bonding materials which have been in heavy demand due to the busy state of the foundries brought about by the high level of production in the car firms.

The company is one of the Laporte Industries group, who have the substantial record for the past financial year of improving their group profit to £3,147,943 before tax, an increase over the previous year of 73·6 per cent.

Laporte Chemicals, which supplies hydrogen peroxide all around the world, has been able to reduce prices as it brought down its operating costs. World production of hydrogen peroxide has considerably increased but not faster than the demand. In his annual report on the group, the Laporte chairman, Mr. P. D. O'Brien, points out that organic peroxide products are an increasingly important part of this company's work.

The Laporte group now contains something that can be called its own Sheffield group. This is made up of three companies brought into the overall concern. They are the Sheffield Chemical Company, James Wilkinson and Son and Glebe Mines, with Laporte Acids, all these firms had a good year.

Profits in Wool but Losses in Asbestos

With its interests widely spread over rayon dyeing and finishing, the woollen trade, asbestos mining, ore carrying and cement, the WILLIAM BAIRD Company, of Glasgow, reports in its yearly review, some losses, satisfactory results from most of the group's companies, and a profit for the year of £298,402, after tax. This compares with £223,672 in the year before.

For the early part of the year there was difficult trading for the group's India Mills, a position aggravated by the findings on the Yarn Price Agreements by the Restrictive Trade Practices Court. A quick change occurred after the publication of the Cotton Spinning Reorganisation Scheme.

At Moss Bridge Mill, while demand and production varied through the year, there was an improvement in the last quarter. The improvement for both mills in the last months of the year was continuing.

Less happy was the year's trading by the BROWN & ADAM company which suffered a reduced turnover. This was caused by over capacity in the rayon dyeing and finishing side of textiles which has led to intense competition and lowered prices to an unprofitable level. Efforts are being made to introduce other fibres and blends for processing, in addition to viscose rayon. Although the chairman, Mr. Thomas H. Thorneycroft, forecasts another loss this year by Brown & Adam he expects it to be very much less.

Early in the year under review the woollen trade recovered from its two-year depression. LAIDLAW & FAIRGRIEVE's mills worked to capacity and their production is being well kept up this year.

In asbestos the price went on falling and REX ASBESTOS MINES again returned a loss. Demand has improved since the end of the year and the accumulated stock has mostly been sold. Asbestos prices are still low.

One of the overseas subsidiaries is the CYPRUS CEMENT company whose plant was kept going all the year at full capacity, selling about the same amount of cement as the previous year. Imports from the United Kingdom were needed to make up the additional demand for cement on the island. Cement demand has recently shown signs of falling. The conditions of political uncertainty on the island having led to some unemployment.

This is a position, following the signing of the agreement for £14 million of British aid for Cyprus, that may reasonably be expected to pick up again.

Television Sets are now Two a Minute

New production methods involving breaking down into groups have enabled a television set manufacturing company to double output with a 50 per cent space reduction.

THE PRODUCTION lines in the General Electric Company's Coventry television factory are claimed to be the most fully automated in the world. They are producing two models a minute, following the introduction of new production methods which have resulted in a 100 per cent increase in output and a 50 per cent saving in space. In addition, these have enabled the company to reduce the cost of direct labour in each television set by one-third, making possible the transfer of effort to other expanding activities within the GEC radio group.

The introduction of printed wiring panels to the industry during the last few years is the key to many of the automatic and semi-automatic techniques now possible. The use of these small panels mounted on a light framework, as distinct from a single massive chassis, has enabled the producing operations to be grouped.

At Coventry, the process starts with copper-clad phenolic board being guillotined to size and pierced with two master holes for accurate location during later operations. After cleaning, the panels go to a pressurised room where the air is filtered to avoid dust. A photo-resist is sprayed on the copper surface, and the panels are placed under photographic negatives in printing machines and held in place by vacuum. After exposure to ultra-violet light, the boards are developed by the action of a trichlorethylene spray to remove the unexposed photo-resist.

The next operation is to remove the unwanted copper from the panel, using a machine which carries out all the processes of etching, washing and drying. Panels are automatically conveyed through this machine, which first sprays ferric chloride on to the copper surface. After removal of residual acid by high pressure water sprays, the boards pass through a drying oven.

Revolving brush scrubbers remove the remaining photo-resist to prevent interference with the subsequent soldering operations. The 300 holes needed for mounting components are then punched. When degreased, the panel is selectively varnished to expose only the areas of copper required for soldering. For convenience in servicing, the component reference numbers are printed on the back by a silk-screen process.

PRINTED PANEL ASSEMBLY

Assembly of panels is in three operations: automatic component insertion, some manual assembly, and dip soldering. The automatic insertion covers most of the resistors, valve holders and capacitors.

The boards are first fed into rows of machines, which incorporate indexing arrangements to progress them from station to station at intervals of a few seconds. At each station from one to four components are inserted by shearing the wires to the correct length, threading them through the holes in the panel and bending the ends over on to the copper surface. The magazines, loaded with about 250 components, are replaced at regular intervals. A reservoir in the insertion head holds sufficient supplies to cover the changeover time. On completion of automatic assembly, the panels are released on to a moving belt serving the manual operators. The wire-ended components inserted by them have the wires cut to length and pre-formed.

After inspection, completely assembled panels are passed through a mechanical soldering machine. A chain conveyor picks up each board presented to it and moves it through the fluxing and soldering stages. Flux is automatically sprayed on the copper surface, followed by infra-red heating and drying. The panel is then allowed to float on a solder bath for a few seconds, after which it is shaken to dislodge any surplus. A very careful inspection of the soldering follows, after which valves are fitted and the panels then pass to the testing machines.

TESTING MACHINES

The equipment in use at Coventry for testing I.F. panels breaks down the work into a series of operations each of which takes the same time, in this case about 25 sec. The machine warms up the valves prior to testing, to allow the performance to stabilise, and automatically positions panels at various stations. When an adjustment has to be made, automatic connections enable the operators to start their work immediately a panel arrives opposite them. The printed panels are inserted into a series of identical trolleys and connections are made by spring-loaded plungers and plugs and sockets. The trolleys are indexed into the test positions by air cylinders, and automatic lifts are arranged at each end of the machine so that the trolleys circulate. Meters, cathode-ray rubes and frequency indicators are at eye level behind the trolleys with the operator controls near at hand, so that no reaching across the test panel is required.

A punched card system shows good or faulty panels, in the latter case the card shows the exact location of the fault.

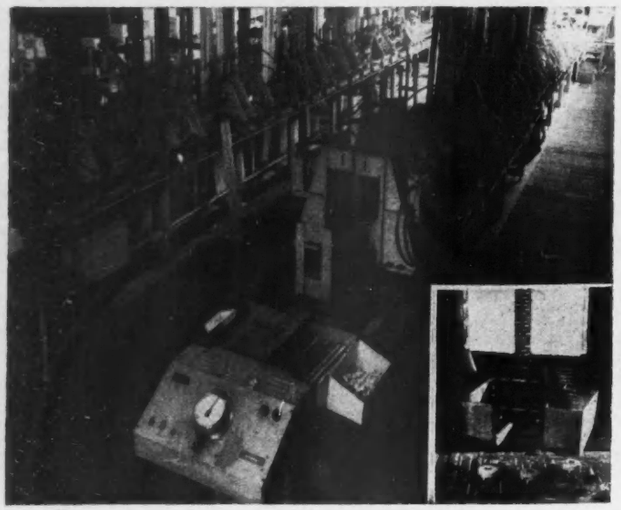
MAIN PRODUCTION LINES

The main production lines start with the metal chassis framework and finish with the receiver in its carton. Assembly operations are carried out on long indexing tracks which position the chassis in front of each operator in turn. The accurate location of the cathode-ray tubes is essential, so that the chassis fits the cabinet properly; a special jig worked by compressed air is used to ensure this. Manufactured items including printed panels, turrets, deflector coils and cable forms are fed to the appropriate positions by colour-coded trays on several conveyors. After the inspection and testing stages the chassis are fitted into cabinets which are supplied complete with protective glass from another overhead conveyor. Automatic lifts take sets which need rectification to a parallel line, whence they return to the first available space in the main flow.

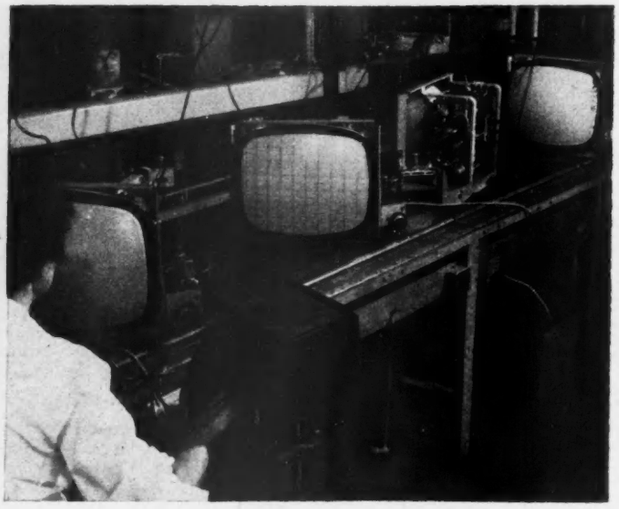
Final test and clearance are followed by packaging, the cartons being prepared on an overhead gantry, dropped over the receiver, and inverted for sealing. A stapling machine adjusts automatically to fit various carton sizes for different models and staples the package top and bottom in one operation. During the summer of 1960 an automatic lift will be installed to convey television and radio receivers from the assembly floors to ground level for loading.

Timing coordination of all the manufacturing operations is ensured by an electronic control system designed and produced in the works.

Television sets and their packing have to withstand a certain amount of violence during transit. Prolonged vibration during long runs will search out any weak points, and so tests are made periodically during the production run. The most spectacular of these consists of a series of drops on all faces and corners of the cartoned television set from a height of 3 ft. There is also a low frequency high amplitude vibration test.

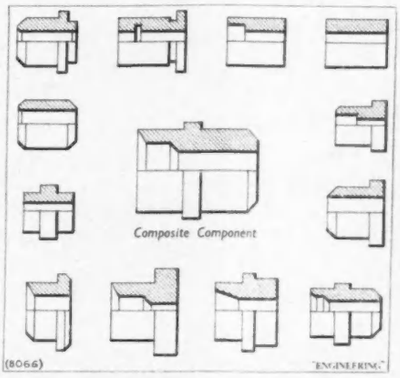


A general view of the mechanical assembly machines, with an inset close-up view of one of the component insertion heads.



Testing the chassis before it is fitted into the cabinet. To allow the performance to stabilise, valves are warmed prior to testing.

Composite Components Give Long Production Runs



In their efforts to increase production runs and hence make automation feasible, the Russians are experimenting with a principle known as "group machining."

If a group of components are broadly similar in size and configuration, their common features may be combined to form a single composite component. This component may be fictitious. The production tool can then be set up to machine this composite component and hence, with only minor adjustments, the entire group. Thus the tooling may be written off over one long production run instead of several comparatively short batches.

The common features of several components may be combined in a single hypothetical composite component, thereby making possible a longer production run.

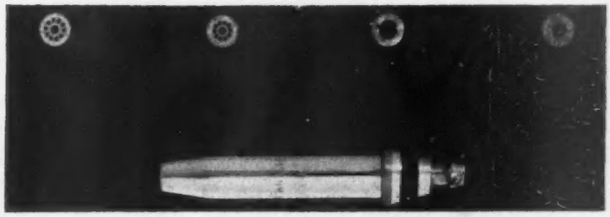
For example, twelve bushings may be combined to form the single complex bush illustrated. Changeover from one bush to another would involve only simple adjustments. Success in this approach depends on the ingenuity of designers and production engineers.

It is reported that the Leningrad Metal Works have compiled 180 group sheets representing 900 component types, with further classification for various sizes. Another factory divided 1,402 components into 138 groups with from 3 to 40 components per group. Tooling costs were said to have been reduced from 725,000 to 102,000 roubles (£65,000 to £9,000) using this technique. Over half the savings arose from the reduced cost of automatic lathe cams.

The same principle is said to have been applied to milling, grinding, diecasting and even electroplating.

High-Speed Flame-Cutting Nozzles

A range of oxy-acetylene nozzles which are said to give faster machine cutting speeds than any existing models have been developed by British Oxygen Gases, Limited. These new high-speed nozzles, shown in the illustration, have been designed for machine cutting applications and are an addition to the "Saffire" range of equipment. They can cut 7 in thick plate at 45 ft per hour and 1 in plate at 100 ft per hour. They are available in four sizes: 45, 50, 60 and 73. The size numbers indicate the diameter of the throat passages in thousandths of an inch.



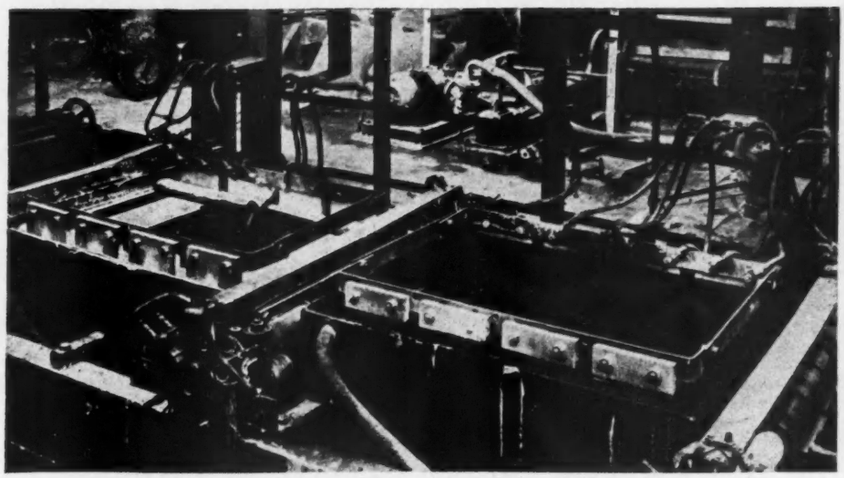
Said to give faster cutting speeds than existing models, a new range of oxy-acetylene nozzles has been developed by British Oxygen Gases Limited.

The new nozzles are expected to lower the production costs of machine cutting and reduce the time spent on finishing and machine work. They are of one-piece construction and, apart from the conical seating surface, are chromium plated. The cutting orifices, which are machined to exacting limits, are of convergent-divergent form. This feature allows the cutting oxygen supply to expand to atmospheric pressure within the nozzle. The cutting oxygen leaves the nozzle at high speed in a parallel stream, resulting in an exceptionally high linear cutting speed.

Pumping Corrosive Chemicals for Electro-Galvanising

Modern plating plants frequently require the continuous circulation of highly corrosive chemicals. In the rolled strip electro-galvanising plant of the Whitehead Iron and Steel Company, Limited, of Newport, South Wales, a Goodyear A 12 positive displacement rubber-to-metal pump has been installed to circulate the galvanising electrolyte. The solution, containing a high percentage of corrosive chemicals—including zinc sulphate, aluminium sulphate and sulphuric acid—is circulated at temperatures up to 120° F through nine tanks used for plating continuous strips of thin, mild steel. The plant is capable of plating up to 300,000 sq. ft of rolled strip per week.

The pump performs this duty 24 hours a day, stopping only when the electrolyte solution is to be renewed or when the anodes are to be replaced in the galvanising tanks. Before the Goodgear pump was installed two centrifugal pumps had been used. They required priming, and during this operation the corrosive liquid was liable to cause injury and damage to clothing. The priming operation took about two hours to complete, during which time the plating line was at a standstill. The delays to production thus caused, and a complaint from the union about damage to clothing and risk of injury, led to an investigation into the possibility of installing a self-priming pump.



Two of nine galvanising tanks for continuous rolled steel strip plate, through which the galvanising electrolyte is circulated by a Goodyear A 12 self-priming pump from the sump in the background.

The Goodyear size A 12 pump was found to be suitable for this duty. It is said to be economical, completely self priming, and will run on any mixture of air and liquid. It is driven by a 5 h.p. Metropolitan Vickers electric motor at 1,440 r.p.m. At less than half the pump's maximum speed, it delivers the 4,500 gallons of solution required per hour.

The pump body and end blocks are of bronze while the rotor and plate wheel, the only moving parts in contact with the liquid, are of stainless steel. The bonded elastomer on the stator and plate wheel is of butediene acrylonitrile, which withstands the corrosive elements in the galvanising solution.

The A 12 draws the electrolyte from a sump through 2 in lead piping and passes it to the galvanising line, whence nine 1 in hoses feed individually to the plating tanks. The solution is returned to the sump by gravity. The pump on this duty is operating at a maximum pressure of 22 lb per sq. in, or approximately 50 ft head, with a suction head of about 10 ft. The pump used by the Whitehead Iron and Steel Company, is capable of deliveries up to 9,000 gallons per hour at 3,000 r.p.m. with heads up to 200 ft and suction lifts of 28 ft, and is made in Meehanite, bronze, aluminium and stainless steel. It is one of a series manufactured by Goodyear Pumps Limited, 44 Brook Street, London, W1, a member of the Holman Group, Camborne, Cornwall.

Salvage Engineering with Sea-Going Tugs

One of the more hazardous engineering operations continually being carried out is the work of salvage tugs on the high seas. Their services are usually called for when weather conditions are worst.

The diesel-electric tug Noord-Holland successfully towed into harbour the cracked Falcon.

THE salvage of the Falcon is typical of the salvor's work. At 8.44 p.m. on a December evening she reported leakage in her engine room. Soon she was to be in danger of sinking. NV Bureau Wijsmuller, Ymuiden, Holland, radioed an offer of the services of the tug Noord-Holland. At 10 p.m. the tug was heading out of harbour into a force 11 gale and tempestuous seas. The firm's services were accepted on Lloyds Open Form (no success—no charge), and the tug Cycloop was also sent out. Both tugs shipped very heavy seas overall.

By 9 a.m. the following morning the tugs had reached the Falcon, after covering about 70 miles. The vessel, was lying very low in the water, listing to port and, with the wind abeam, was shipping heavy seas all over. From the tug a crack about ½ in wide could be seen down the starboard side. Engine room and stokehold were waterlogged, and there was no steam.

In spite of the heavy seas, a salvage engineer, tug captain, and two of the tugs' crew were aboard the Falcon by 1 p.m. The Noord-Holland closed with the Falcon and the men on board tried to haul the tug's 5½ in steel cable aboard by hand. Their hauling line broke and the heavy seas threw the tug's stern against the bow of the Falcon, doing damage to both ships. The Noord-Holland went off to haul in her cable and the Cycloop closed with the Falcon. The crew succeeded in hauling her 4½ in cable on board and made it fast to the ship's port bow. This was accomplished at 1.45 p.m. The other tug connected at 3 p.m.

In the Falcon's engine room the water was several feet deep. At times the crack in her hull widened with the motion of the ship. Between attempts to make the tugs lines fast, opportunity was taken to plug the crack with rope and canvas. In this way many tons of water were prevented from entering the ship.

TYPICAL TROUBLES

The tugs started to tow slowly towards Ymuiden. Before night fell a lifeboat took the master, wireless operator, and two trawler men off the Falcon but remained with the salvors during the night in case the vessel foundered. Even though the wind moderated to force 6 during the night, the vessel became more difficult to control. In the morning, soundings showed there to be 26 ft of water in No. 1 hold, which had made the Falcon down by the head, causing her to sheer wildly. The engine room contained about 10 ft of water.

Six miles from Ymuiden the tugs had to alter course to approach the pier. This brought the wind on the Falcon's port quarter and she started sheering badly to port, listing to starboard. As a result, the greater part of the crack in her starboard side was constantly under water and the depth of water in her engine room increased. Heavy squalls accentuated the seriousness of the situation, and the vessel was thought to be in immediate danger of sinking. Nevertheless the Falcon was towed into harbour successfully and put on the soft mud of the Berghaven. Five days later she was towed to Amsterdam for repairs,

Later in the same month, Cycloop put out at 4 a.m. into a force 11 gale to go to the assistance of the Katingo, which had gone aground. In this case it turned out that salvage engineers were able to travel to the scene by car, but the salvage operation was a lengthy one. The vessel went aground on 21 December and was not freed until 19 February. At first draglines were used to remove sand from around the ship. Then in January a dredger was brought overland, assembled in a day, and set to work around the ship. It had to shift thousands of tons of sand. Eventually the Katingo was pulled off, with the aid of four tugs, her own power, and heavy ground tackle (2 and 2½ ton anchors). She floated just after midnight, the operation taking place in a snow storm.

The salvage of the Swiss vessel Nyon was a different story. She went aground so firmly on the rocks off St. Abb's Head that only her after part with valuable propulsion and steering machinery could be salvaged, the forepart being abandoned. Pumps, bottles of oxygen and gas, flame cutters, steelplate, and cement were brought aboard the vessel from tugs. The first operation, once the decision to cut the ship in two had been taken, was to weld the hatch bridle seams, and stiffen the deep tank bulkhead and the tank top. At low tide it was possible to gain access to fractures in the deep tank and to weld them, at the same time plates were fabricated into cement boxes. When all water and oil pipes leading from the tunnel to the engine room were cut and wood plugged, flame cutting of the hull was started, the tunnel being welded over with plate.

A few hours after starting cutting, the operators had cut through the hull from the bulwarks down to the turn of the bilges, which was as far down as the men could get at low water. The tank tops were also cut right across. Four tugs made fast to the after part of the Nyon and started to tow at full power, sheering from port to starboard as much as possible in an endeavour to fracture the bottom plates. No success was achieved, nor did the rise and fall of the tide fracture the keel either.

At low tide, the cut opened up to 2½ ft on the deck and 1½ ft down the sides. As it seemed likely that, in the conditions prevailing, the tugs would take a long time to part the bottom plates at the cuts, the use of explosives was accepted. After a series of explosions, using light explosives packed in sand, the two parts of the ship separated. The after part was not leaking and had satisfactory buoyancy and stability. It was towed to North Shields and was reconstructed.

The sea-going motor tug Stentor was specially designed for salvage work off the Dutch coast.

Wijsmuller have a fleet of 12 motor tugs of which 10 are ocean-going, ranging from 1,200 to 2,600 i.h.p. Much of the company's work is long-distance towing. The 548 ton Noord-Holland, for example, towed the aircraft carrier Tripoli from New Orleans to Hirao, Japan, for demolition purposes. The voyage of 10,000 miles was completed in 75 days.

Automatic Signal Warning on British Railways

An automatic warning device, which gave audible and visual signal indications to locomotive drivers was installed by the Great Western Railway Company on all its main lines before the war. A second system, the Hudd, was adopted by the London Midland and Scottish Railway Company, and the line from London Fenchurch Street to Southend was equipped with Hudd equipment by 1947.

Both systems were satisfactorily for the type of work for which they were designed, but they were unsuitable for country-wide application, and neither could be used with all forms of traction. British Railways therefore developed a new automatic warning system, combining the best features of both the existing ones. The new BR system can be used with any form of traction, is unaffected by heat, snow or ice, and is universally applicable over the whole BR system. Having developed suitable apparatus, British Railways planned to equip five principal routes with it by 1963. This work is progressing well and after the first five main routes have been equipped, the system will be extended to other main lines within another five years.

The BR system gives an audible warning on approaching a distant signal, sounding a bell for "clear" and a horn for "caution," and applies the train brakes automatically if the driver fails to acknowledge a caution warning that the next stop signal is at danger. A special feature of the system is that a visual indicator remains in front of the driver after he has cancelled a caution, to remind him that he has taken over complete control of the train. This indicator subsequently resets itself, when the next distant signal is passed.

The principal routes to be equipped with the BR warning system during the initial five-year period were: London (Kings Cross) to Edinburgh via Newcastle; London (Euston) to Liverpool, Manchester and Glasgow; Edinburgh to Glasgow; London (Waterloo) to Bournemouth and Exeter; and London (Liverpool Street) to Norwich. When the installation programme started, 105 miles of the main line between Kings Cross and Grantham were already fitted with ground apparatus, and some 50 locomotives had receivers. This was the test section. Automatic warning is now installed on all four tracks of this former experimental length, and has been carried northwards to Newcastle, a total of some 270 route miles, involving the provision of ground apparatus at every distant signal on over 778 miles of track. All the tracks of the Scottish section of this route, between Edinburgh and Bournemouth, have been similarly equipped, and there only remains a gap between Newcastle and Bournemouth to be closed.

Elsewhere, equipment has been installed on the Edinburgh-Glasgow main line, and from Euston to Stafford on the London-Glasgow line. Ground apparatus is being fitted between Manchester and Crewe, in readiness for the opening of the first stage of the main line electrification from London. Progress is also being made on the suburban lines from Liverpool Street, and on the Southern Region from Exeter to Salisbury. It was estimated when the programme started that about 1,800 miles of track and some 10,000 locomotives would be fitted with the BR system by 1963. In less than two years more than one-third of the route mileage and nearly one-fifth of the locomotives have been equipped.

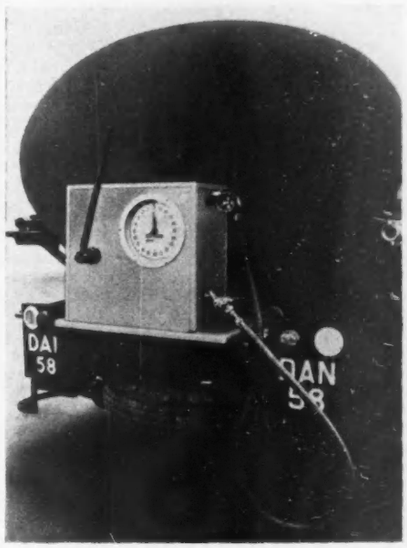
Pricing On-Site Refuelling

Designed for static or mobile use, the model 100 pump introduced by E. and E. Pump Services Limited, Limes Place, Limes Road, Croydon, can be used for paraffin, diesel and fuel oils. It is 24 in high, 24 in wide and 12 in deep, and can thus be mounted without difficulty on a tank vehicle. As shown in the accompanying illustration, it is so mounted, and used for retail sales. Being Board of Trade approved, the pump unit can be used for determining sale charges of fuel as indicated by the meter. Lorry mounted, it would be equally suitable for site refuelling of excavators and other contractors' plant, or for the refuelling of agricultural machines.

The pump unit—a No. 5 semi-rotary hand pump—meter, indicating dial and spring loaded check valve are all mounted in a welded steel angle frame, and enclosed in a weatherproof, detachable sheet metal casing. The amount of fuel delivered is indicated on a circular dial 10 in diameter, with one hand recording one gallon per revolution, while a second, smaller hand shows the number of gallons up to 20. A totalising counter is incorporated, in the pump, that gives reading up to 99,999 gallons.

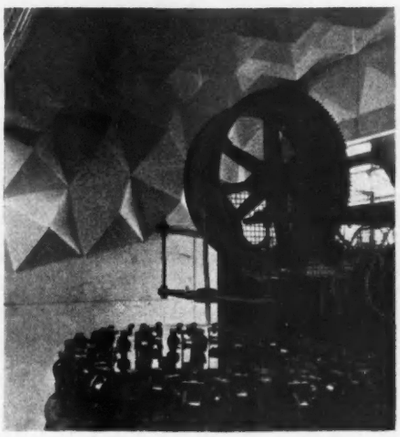
Fuel delivery is through an 8 ft long ¾ in diameter black rubber hose, fitted with a swivel coupling which enables the nozzle to be offered to the receptacle without twisting. A quick action nozzle is fitted, with a check valve to obviate the necessity for draining the hose after delivery.

When the equipment is used for resale purposes a low-level cut-off valve is supplied and fitted between the tank and the pump; this renders the pump inoperative when the tank is empty. If the unit is used for other purposes, as for example, for fuelling a contractor's earthmoving fleet, the cut-off valve is not required.



Fuel can be delivered from a static or, as here, the rear of a mobile tanker for door-to-door sales or to contractors' plant.

Taking the Noise out of Industry



Noise from machines is absorbed by acoustic pyramids, making working conditions tolerable.

Noise, making working conditions intolerable, is one of the problems of modern industry. The Marley Group, Sevenoaks, Kent, have tackled numerous noise problems, with successful results.

At the Watford factory of Smith's Motor Accessories five braiding machines caused such a noise that a remedy had to be found. Marley lined the lower 6 ft of the walls behind the machines with felted mineral wool slab, and installed three rows of acoustic pyramids above this lining. A false ceiling was erected, and covered entirely with acoustic pyramids. As a result there was a 49 per cent reduction in apparent loudness.

Similar noise conditions were present in the m.v. Thameswood, belonging to the Constantine Shipping Line. Communication in the engine room was impossible, even by shouting, and conditions in the accommodation above it were made uncomfortable by the noise, which penetrated even to the navigating bridge. Three hundred Marley acoustic pyramids were installed, the whole of the work being carried out while the ship was in service; some of it was done while the vessel was at sea. Measured results showed a four-fold reduction in the overall noise level, a decrease of six decibels. With two generators, two blowers and the main engines all running it is possible to converse in near-normal tones, and conditions in the accommodation spaces are much improved.

In the Research Laboratories of Allen West and Company Limited at Brighton, the requirements were somewhat different. Here the need was for an echoless room where control gear could operate without undue noise, such as magnetic hum, and where high voltage discharges could be detected aurally and visually—often in complete darkness. This was met by lining the walls and ceiling with acoustic pyramids.

On the Shelf

By Frank H. Smith

I HAVE mentioned before the *Occasional Papers* of the University of Illinois Library School (Urbana, Illinois). No. 58 is the latest. It is "The Literature of Library Technical Services" and is a survey of the publications in the fields of interest of the resources and technical services division made by the division's publications committee with the aid of several specialists (it says). There are seven sections, each starting with "The literature of" and going on to "technical services" (by the university acquisition librarian), "acquisitions" (by the assistant director for technical services, Washington University), "cataloging and classification" (by the assistant director for preparations, University of Chicago), "serials" (by the head, East European Accessions Index Project, Library of Congress), "document reproduction" (by the specialist for Documentary Reproduction at Harvard), "interlibrary cooperation in technical services (by the head, Interlibrary Borrowing Service, University of California), and "library resources" (associate professor, University of Illinois Grad. School of Library Science). They've crammed all this lot into a 48 page paper, which I consider amazing. It could so easily have been a seven volume book.

Architects are, by inference, not information minded. Professional and Industrial Publishing Company Limited (Mercury House, 109-119 Waterloo Road, London, SE1) have found that only 3·8 per cent of architects surveyed employed librarians, only 10·7 per cent housed catalogues in special containers, and various other figures. So they offer a Building Products File and I suggest you ask them for the facts.

If you write to "Careers," 77 High Street, Chislehurst, Kent, you will get full particulars of a new publication, to appear in October, which will be "a vital link between employer and student." Three times a year in mid-term it will be free to all university deans and profs., head- and career masters and so on. The student—he can get it at 1*s* 6*d* a time.

The Fédération Européenne de la Manutention (52 Lincoln's Inn Fields, London, WC2) are producing an "Illustrated terminology of mobile cranes" and have already produced the proof. It's an excellent job, running to six languages and with diagrams to show you where the pieces fit in when you've found out what they are called.

If your reading matter runs to wiggly lines chasing themselves endlessly across a screen, invest in the second edition of *Encyclopaedia on Cathode-Ray Oscilloscopes and their Uses* by Rider and Uslan (Chapman and Hall). This makes me wonder—encyclopaedia on? encyclopaedia of? or just so-and-so encyclopaedia?

I suspect there is somebody in the library of the British Coal Utilisation Research Association who is old enough to have served in the First World War. They have a stock loans card which reads:

May we please { borrow / renew our loan of / have the return of }

Anybody who has ever seen a field postcard used by the PBI will know what I mean if they remember:

I am { fit / wounded / half dead / unhappy }

Heinemann (William, of 15-16 Queen Street, London, W1) have some new scientific paperbacks. There are five for a start at 4*s* 6*d* and one title at least will fool 'em on the bookstalls: *Echoes of Bats and Men* by Donald Griffin. Just imagine being half-way to Crewe before you realised that Rhinolophus Lustus did not play for the West Indies but was a leaf-nosed bat! Six further titles are promised for January, 1961.

Needles in a Haystack

Punched Cards: Their Applications to Science and Industry. Edited by ROBERT S. CASEY and others. 2nd edition. *Reinhold, New York; Chapman and Hall, London.* (120*s*)

Tools for Machine Literature Searching. By J. W. PERRY and ALLEN KENT. *Interscience Publishers, New York and London.* (210*s*)

Information Systems in Documentation. Edited by J. H. SHERA, A. KENT and J. W. PERRY. *Interscience Publishers, New York and London.* (96*s*)

Our material civilisation could not have developed without the human ability to communicate by speech, and to record facts, thoughts and calculations by written and printed documents. These documents, rather than the material objects or processes they describe, make it possible for each generation of technicians and scientists to stand on the shoulders of their predecessors. The emphasis is on the word "possible," for the documents must be filed in such a way that the information, relevant to the problem of the moment, can be readily located.

A century ago this requirement was fairly adequately fulfilled. In most fields of knowledge all the available information could be collected into very few text books. Recent developments could be followed by scanning a small number of journals. Since then the progress of invention and research has continued at an exponential rate, and the volume of the printed record can only be described as appalling. Fifteen years ago this situation was most stimulatingly discussed by Vannevar Bush ("As We May Think," *Atlantic Monthly*, vol. 176, 1945, p. 101), who stated: "The investigator is staggered by the findings and conclusions of thousands of other workers—conclusions which he cannot find time to grasp, much less to remember, as they appear. . . .

"Mendel's concept of the laws of genetics was lost to the world for a generation because his publication did not reach the few who were capable of grasping and extending it; and this sort of catastrophe is undoubtedly being repeated all about us, as truly significant attainments become lost in the mass of the inconsequential."

The science of documentation has been developed to cope with this sort of situation. Specialised journals devoted solely to abstracts of original publications are now published (some fields of engineering are very poorly served in this respect). To increase their usefulness, ingenious numerical classification systems have been developed, in which broad fields of knowledge can be found by a combination of two or three figures, and particular topics can be located as a result of successive subdivision into decimally divided classes.

These aids are of immense help, but they are still inadequate for the task. Because of the mere mass of publications, it has not proved practical to file one published article under more than one—or at the very most two—aspects. In fact, it is the usual custom to file original papers by the topic representing the centre of gravity of the *results* obtained. Ancillary aspects may ultimately prove to be of equal or greater significance, but the probability that they will be seen by the workers who can use them is minimal.

A particularly grievous aspect of this situation is that filing systems seldom indicate the methods used to obtain results, unless a separate paper about techniques is published. Yet knowledge about experimental techniques and laboratory methods is often as important to the research worker as information about the results obtained. For example, a recent article contains a description of a novel and ingenious microdensitometer operating at exceptionally high magnification. The article was primarily concerned with the penetration of dyes into gelatin layers during the production of coloured motion pictures, and was most unlikely to be found by crystallographers, spectroscopists, astronomers or other scientists potentially interested in such an instrument.

These problems are most serious and difficult, but Vannevar Bush pointed out that the very scientific developments which have created the problem have also fashioned the components likely to be needed for its solution. He cited "Photocells capable of seeing things in a physical sense, advanced photography which can record what is seen or even what is not, thermionic valves . . . cathode-ray tubes rendering visible an occurrence so brief that by comparison a microsecond is a long time and relay combinations which will carry out involved sequences of movements more reliably than any human operator and thousands of times as fast."

These three books record different aspects of the massive attacks which have been launched on these problems, particularly in the United States. All are necessarily concerned (*a*) with the coding of entries to a file, (*b*) with the physical form of the file with machine sorting of the entries where applicable, and (*c*) with the mechanical retrieval of entries pertinent to the searcher's requirements.

Punched Cards deals with systems for handling information, which in their simplest form use cards with holes in a hundred or more positions punched round the edges. Aspects or characteristics of potential interest are recorded on each card by punching at appropriate places, so that the hole is replaced by a notch in the edge of the card. The centre of the cards has an adequate area for the insertion of bibliographical details, and a short abstract for each entry. The capacity of the coding system represented by the punched notches is high in view of the 100 positions for notching and is often extended by using more than one row and punching notches of different depth.

With these cards it is possible to code each entry by many different aspects, an arrangement which permits the following sort of operation. A classification system for identifying cars, for example, could use separate groups of notches to denote respectively the make, age, engine size, colour, and so on. To find cars of one particular make, a needle is inserted through the appropriate hole in a stack of cards and, on shaking, all the appropriately punched cards drop out irrespective of their original position in the stack. Repetition of this operation is used to select for each characteristic, and a number of independent variables may be sorted simultaneously. Such hand-operated systems represent a convenient and flexible tool for handling files of up to several thousand cards.

The book is the second edition of a work first published in 1951, since when developments have warranted rewriting or replacement of 26 out of the 30 chapters. Its primary purpose is to enable individual scientists, engineers and technologists to apply punched card techniques to their own technical information, which tends to become unwieldy even in files of very modest size. Sections on basic principles, applications in specific fields, coding and systems design, and future possibilities of mechanised punched card systems for data processing consist of self-contained papers by 30 contributors. The editors recognise that this method introduces some overlapping and repetition, but feel that this is not wholly undesirable in view of the present undeveloped state of the art.

Chapters of special interest deal with filing and searching in metallurgical literature, the use of punched cards in preparing reports, papers and books, the "peek-a-boo" system which was specifically developed for searches in connection with instrumentation, and the use of an IBM ESM-101 card-sorting machine for classification, searching and mechanisation in the US Patent Office.

The book also deals in less detail with applications of machine-sorting systems originally developed for accounting, and the use of punched

cards in library routines. This is a controversial subject, and some documentalists are critical of the limitations of punched cards in this field.

Vannevar Bush's article contained the statement: " For mature thought there is no mechanical substitute. But creative thought and essentially repetitive thought are very different things. For the latter there are, and may be, powerful mechanical aids."

In *Tools for Machine Literature Searching* it is noted that these precepts have already been extensively applied to the handling of numerical data and much of the drudgery of repetitive arithmetical operations has been eliminated by electronic computers. Possibilities of applying analogous methods to non-arithmetical operations have not been so quickly understood, and proposals for machine translation were not so long ago considered ridiculous. Nevertheless, alert organisations realised that the more efficient use of information could be of decisive importance in planning and conducting research, and in making business decisions, especially in evaluating markets and competitive situations. A wide range of manual and automatic devices has been applied to these information problems; but since many of the devices were not specifically designed for searching, selecting and correlating operations, the potential benefits tended to be obscured by limitations of the equipment or system. In spite of this, the pioneering efforts established basic principles for analysing information so that it might be searched and correlated by specially designed automatic equipment.

A research programme was initiated at Western Reserve University for the purpose of formulating methods for applying existing or anticipated developments in electronics to providing ready access to information stored in extensive collections of documents. *Tools for Machine Literature Searching* has been written by two of the leaders in this project, and describes a new encoding system and retrieval equipment and the status of the problem after ten years' work.

The first of the book's four parts is a summary of logical principles on which the information retrieval system is based. The second part, " engineering of machine literature searching systems," considers the characteristics of existing systems and the limitations they impose. This incorporates an interesting discussion of costs, including " hidden " costs. By these are meant costs incurred by examining irrelevant documents produced by a system, by not finding information which is in a file, or by not attempting to use information known to be in the file because of a conviction that the equipment would never find it.

The third and largest section deals with procedures for analysing, encoding and searching information, and the Western Reserve University Searching Selector developed for this purpose. A particularly interesting part of this section is the method chosen to code entries, for no automatically operated file can operate without appropriate coding of entries. Coding is of critical importance, since the care and consistency and thoroughness with which it is done is a decisive factor in the subsequent success of any type of search. For automatic searching systems it is even more essential, since machines cannot be endowed with the imaginative insight, whereby human searchers may sometimes find entries in spite of deficient coding. Coding at Western Reserve University is based on the use of a specially designed " machine language," or " semantic code," in which " words " symbolise concepts but avoid the ambiguities and illogicalities of human language. The final section of the book, some 350 pages long, comprises a dictionary of English to semantic code and *vice versa*.

This book is one unit in a series which is being written to provide a coordinated group of treatises for training librarians in new and rapidly developing techniques. It is a portent of the spread of automation into this field, which is tending to convert libraries from passive repositories of books into active information centres. To the non-librarian it is a fascinating but difficult book, and for fullest appreciation probably needs considerable knowledge of such subjects as linguistics, information theory and computer programming. On the grounds that it is the first really useful book on machine literature searches and also offers a progress report on a most far-reaching piece of research, it should be studied by all concerned with the problems of information retrieval.

Information Systems in Documentation presents papers read at a Symposium on Information Retrieval held at the Western Reserve University. The papers were primarily concerned with specific applications and case histories. Its contents are of interest to those concerned with devising systems or applying them to specific problems. It is clear that solutions to information retrieval problems are by no means yet " cut and dried," and study of this book should assist prospective users to visualise the possible outcome of installing a system themselves. Of particular interest are discussions of applications in the United States and the Australian Patent Office, in the production of *Applied Mechanics Reviews* by the American Society of Mechanical Engineers, and in the fields of metallurgy, instrumentation, armour-piercing ammunition and fuel and lubricant additives.

A particularly thought-provoking chapter is entitled " Soviet Mechanisation of Information Processes." In addition to the same problems facing Western scientists, Soviet workers have to cope with limited access to foreign scientists, and the constant possibility that existing personal links may be cut by political events. For these reasons one of their computer experts has written " In the next few years our scientists will have the task of developing a series of high-speed machines for analysing the content of a world fund of scientific and technical literature . . . the development of such a machine requires greater work on the part of the Academy of Science and Industry." In the opinion of the author of this chapter, their motives for such research are strong enough to ensure that it will not suffer from lack of personnel or funds.

Future Soviet mastery of these problems could make a major contribution to their stated objective of equalling and surpassing the technical and economic development of the Western World. If we neglect these problems, it will be to our own peril.

G. W. W. STEVENS

High Vacuum But Bursting at the Seams

Neues und Bewährtes aus der Hochvakuumtechnik. By GÜNTHER CHRISTIAN MÖNCH. *VEB Wilhelm Knapp Verlag, Halle (Saale), Germany.* (98 *DM*)

Vacuum techniques have developed considerably in the last ten to twenty years and are finding increasing application in a wide field of industry and research. It is therefore appropriate to see comprehensive books published on this subject. There are a number of books available now concerned with the essential vacuum equipment; required to obtain and measure low pressures, that is dealing with vacuum pumps, vacuum gauges, valves, traps, and so on. Another important aspect which is not so well covered is concerned with vacuum techniques themselves, such as the special properties and treatment of materials, the correct use of components, and the design of pumping equipment for different duties. The book under review is a work of the second type and the selection of subjects to be included for this purpose is undoubtedly difficult. The choice should take account of the large number of apparently unconnected properties and experimental techniques which are of interest to different workers using high-vacuum equipment; in practice both the selection and emphasis would appear to depend to a large extent on the personal experiences of the author and his view of the subject.

The author of the book under review is well known for his previous publications on this subject, particularly his small, handy and in its time up-to-date volume on " Vacuum Techniques in the Laboratory " (in German, published about 1937). During the Second World War this was of sufficient general interest to be reproduced together with other " classical " German books, under special licence in the USA. In 1950 this was followed by a complete revision under the (translated) title " High Vacuum Technique." The present volume is intended to serve as a supplement to the 1950 edition and it is immediately evident that it is written with a definite " laboratory techniques " flavour and bias.

Compiling this volume of almost one thousand closely printed pages is probably about the maximum that any one person is capable of carrying out in a limited time on any technical subject in which techniques are subject to constant development and change. It is also clear that a book of this size cannot help but be a mine of information. On closer inspection it turns out to be disappointing in a number of ways, particularly in the proportion of rather useless and unimportant material which can only be described as " padding."

The presentation and printing are to a high standard and the volume is very lavishly illustrated with over two thousand line diagrams and photographs in addition to a large collection of tabulated data. Unfortunately, here too there is much superfluous material. For example, there are as many as 27 separate reproductions of photographs showing the external views of rotary mechanical pumps. There are several tables amounting to nothing more than catalogue summaries of types of pumps and performance data as claimed by the manufacturers with similar tables of materials such as greases, oils, etc. As there is no general agreement between firms on the interpretation of such data the direct comparison can be quite misleading. Furthermore, such data is soon out of date and this is already the case in a number of instances.

The worst example of padding in the diagrams is a reproduction of a photograph showing two tubes of silicone vacuum grease with a caption describing the external colour of the tubes.

Apart from such blemishes many sections of the book would be found useful to anyone concerned with experiments involving high vacuum, particularly if he is interested in electronic devices. The first third of the book is devoted entirely to the properties of materials used in vacuum techniques including for example 130 pages on glasses and ceramics, and this part covers similar ground to the well-known books by Espe and Knoll and more recently Kohl. Materials are touched on again towards the end of the book dealing with glass windows, fluorescent screens, glass-metal seals for electrodes, cathodes and thermionic emission, heating in vacuum, glass blowing techniques, soldering and brazing, etc. The arrangement of the subject matter could be criticised and the reader is well advised to make good use of the comprehensive index that is provided.

A section is included concerned with the preparation of thin films by sputtering and evaporation based on a booklet previously published by S. Methfessel *et al.* Again it is strange that this section is about 50 pages removed from a description of laboratory vacuum coating plants. English-speaking readers will find this section quite inadequate in view of the availa-

Continued on next page

bility since 1956 of the book by L. Holland devoted entirely to the subject.

The preface contains the statement that in the references preference is given to German sources. While this is understandable from the point of view of ease of access to such material, it leads to situations where the historical development of a process is distorted. An example of this occurs in the brief treatment on the getter-ion pump. This policy also means that the large list of references and bibliography is *not* aimed at completeness and this rather detracts from the value of the book for reference purposes.

WALTER STECKELMACHER

Purification by Freezing Segregation

Zone Refining and Allied Techniques. By N. L. PARR. *George Newnes.* (40*s*)

In the comparatively short period since its introduction zone refining has been widely proven on a laboratory scale. The simple mechanism of moving a "solidification part" through an impure substance and utilising the well known phenomenon of freezing segregation to redistribute the impurities has appealed to workers in many fields, and a large number of papers on the technique have appeared in journals. With the notable exception of Pfann's volume on zone melting very little has appeared in book form, and Mr. Norman Parr's survey of the subject is, therefore, a timely contribution to the literature on high-purity materials.

The author will be known to many for his brief but clear exposition of zone refining published in monograph form by the Royal Institute of Chemistry. His present work is based on this monograph, expanded with a wealth of experimental detail and augmented by descriptions of associated techniques. Mr. Parr's practical approach to the subject results in an easily readable book which will be intelligible to most engineers.

The theoretical aspects of segregation during solidification and the practical requirements of the process are dealt with in the first three short chapters. The author, in common with other writers on the subject, refers to volatilisation, sublimation, flotation, and outgassing as secondary effects which can result in purification during zone refining. While in favourable cases segregation is undoubtedly the mechanism capable of the ultimate purification there is little doubt from some of the reported results that these other effects, acting individually or in combination, can play a role as important and often more important than segregation.

The next eighty-four pages, comprising about half the book, deal with the design of zone-refining equipment. Methods of producing, containing, moving and controlling a molten zone and its containment in vacuum or gas environment are discussed separately and then considered collectively by reference to existing designs of zone refiners. This section is lavishly illustrated and there are few who, having read it, will not feel themselves capable of constructing zone-refining equipment.

The third section of the book is a fairly broad consideration of methods which may be used in the handling of high-purity materials. It touches on many topics from vacuum melting and processing to single-crystal growth and transistor production. Inevitably when so much is compressed into the space of forty pages the expert in any one of the subjects discussed may find omissions or minor points of disagreement. This section will, however, serve as a guide to the techniques available.

The two concluding chapters of the book deal with the examination, properties, and uses of high-purity materials. The author considers some possible future applications of high-purity materials, among which are some "tonnage" uses. Refreshingly, and unlike some writers on the subject, he makes no extravagant claims for the ability of zone refining to fulfil the needs for these materials. The commercial future of zone refining is greatly dependent upon the development of larger-scale, possibly continuous, and certainly less costly methods of applying the technique. Failing such development the process will be restricted to the purification of small quantities of material for special purposes.

This book will appeal particularly to the practical man. It will serve both as a textbook on zone refining and as a work of reference on the design of zone-refining equipment. In these capacities it is well served by an adequate index and an extensive bibliography which contains many references both to the practical and the more theoretical aspects of the subject.

R. E. KEMP

New Books

Differential Equations for Engineers. By PHILIP FRANKLIN. *Dover Publications, New York; Constable, London.* (13*s* 6*d*)

This text is the outgrowth of a course given for over ten years to electrical engineering students in their third year at the Massachusetts Institute of Technology. A facsimile reprint of *Differential Equations for Electrical Engineers* published in 1933.

Bulletin de l'Association Technique Maritime eq Aéronautique. No. 59: Session de 1959. *Association Technique Maritime et Aeronautique, 47 rue de Monceau, Paris.*

The 30 papers in the current volume include coverage of pressurised water reactor systems for merchant ships, non-destructive testing of metals, marine electrical systems, and STOL aircraft.

Overseas Newspapers and Periodicals Guide Book, 1960. 7th edition. *Publishing and Distributing Company.* (30*s*).

Advertising and subscription details of over 2,000 newspapers and periodicals published throughout the world, with introductory economic notes on each country, and a classified index of subjects.

Port Operation and Administration. By A. H. J. BOWN and C. A. DOVE. 2nd edition revised by E. S. Tooth. *Chapman and Hall.* (45*s*)

First published as a series of articles in *The Dock and Harbour Authority*, this comprehensive account of port organisation and cargo and passenger traffic handling has been written with "one eye glued upon the syllabus of the Institute of Transport." The new edition lays special emphasis on the newer methods of materials handling.

Engineering Design with Rubber. By A. R. PAYNE and J. R. SCOTT. *Maclaren and Sons.* (50*s*)

Based on a symposium organised in October, 1958, by the Research Association of British Rubber Manufacturers, this book is intended as a practical manual on dynamic properties and design with rubber. Appendices cover British and US standards, tests and properties of natural and synthetic rubbers.

Using Centrifugal Pumps. By E. ALLEN. *Oxford University Press.* (30*s*)

In a number of fields urgent temporary or semi-permanent installation of pumps is required; this book deals with the centrifugal pump from the point of view of the user and particularly of staff responsible for the efficient operation and maintenance of pumps and their emergency repair or installation.

Plasma Physics and the Problem of Controlled Thermonuclear Reactions. Edited by M. A. Leontovich. Volume 3. *Pergamon Press.* (160*s*)

A large selection of articles, previously unpublished, on the theoretical and experimental investigations carried out at the Institute of Atomic Energy of the USSR Academy of Sciences between 1951 and 1958.

Hot Organic Coatings. By RAYMOND W. SEYMOUR. *Reinhold, New York; Chapman and Hall, London.* (60*s*)

This book was reviewed on page 96 of the 15 July 1960 issue of ENGINEERING, but inadvertently the word "Hot" was omitted from the title.

The Reviewers

Dr. G. W. W. Stevens, F.R.P.S., is research group leader in the research laboratories of Kodak Limited. He obtained an Sc.D. in chemistry at Cambridge and is author of *Microphotography* and *Photography at Extreme Resolution.*

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Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Instruments

Soil Moisture. SOIL MECHANICS LTD., 65 Old Church Street, London, SW3. Combined surface density and moisture meter for soil compaction operations. Illustrated folder.

Thermometer Regulators. CAMBRIDGE INSTRUMENT CO. LTD., 13 Grosvenor Place, London, SW1. Stock models of thermometer regulators; four types, many ranges. List 176.

Auto Controllers. NEGRETTI AND ZAMBRA LTD., 122 Regent Street, London, W1. Electric contact step action automatic controllers and alarm mechanisms for pressure, temperature and valve operation. Catalogue R30/2E.

Transducers. SALFORD ELECTRICAL INSTRUMENTS LTD., Silk Street, Salford 3, Lancs. Electromagnetic transducers for instrumentation control. Types for pressure, temperature and loading; also indicators and recorders for use with them. Illustrated brochure gives details, diagrams and ranges.

Temperature Measurement. JAMES GORDON AND CO. LTD., Dalston Gardens, Stanmore, Middlesex. Instruments and recorders for temperature measurement in boiler plant, heating and ventilating systems and other purposes. All details in illustrated catalogue 182.

Lighting Control. RADIOVISOR PARENT LTD., Stanhope Works, High Path, London, SW19. Automatic lighting control unit Mark X/C for operating artificial lighting according to the intensity of natural light. Particulars and description given in leaflet.

Photoelectric Relay. PHOTOELECTRONICS (M.O.M.) LTD., Oldfields Trading Estate, Oldfields Road, Sutton, Surrey. Photoelectric relay and light beam for general control work. Leaflet.

Comparator. TEDDINGTON INDUSTRIAL EQUIPMENT LTD., Sunbury-on-Thames, Middlesex. Pneumatic comparator using capsules. Leaflet.

Timers. VENNER LIMITED, Kingston By-Pass, New Malden, Surrey. Mechanically and electrically operated timing clocks and watches for all purposes. Catalogue.

Industrial Television. PYE LTD., 9 Upper Berkeley Street, London, W1. Closed circuit industrial television for different industries. Various leaflets for each.

Light Measurement. BALDWIN INSTRUMENT CO. LTD., Brooklands Works, Dartford, Kent. Instruments for measuring quantity, intensity and transmission of light. Listed in brochure 202.

Marketing

Anglo-US Conveyor Makers Agreement

BROWN, Lennox and Company, the Pontypridd, Glamorgan, makers of heavy duty materials handling equipment for the steel industry, have reached an agreement with the PALMER-BEE Company, of Detroit, Michigan, USA. Brown, Lennox obtain the rights to produce Palmer-Bee heavy duty conveyors and auxiliary equipment for rolling mills.

The Welsh firm will make the equipment to Palmer-Bee designs and specifications and will also do the installation.

Brown, Lennox were formed in 1806. Its handling equipment is used by the non-ferrous metal industries as well as by the steel firms. Palmer-Bee, formed 99 years later, are a noted American engineering firm with main activities in the design, production and erection of material handling conveyor systems and in power transmission equipment. Certain Palmer-Bee original work has been in heavy duty handling and auxiliary equipment for steel strip production and in flat and shaped products.

Elliott Expansion in Australia

The expanding industries of Australia are as modern as many in their methods and it is no surprise that their utilisation of automation is comparatively well ahead.

Control instrumentation in recent months has seen a sharp increase in demand and there has now been a development to meet this in the ELLIOTT-AUTOMATION group.

Elliott have now formed an Australian company, ELLIOTT-AUTOMATION (Pty), which will gradually take over the interests of the existing Elliott subsidiaries. These are the FISHER GOVERNOR Company and the ELECTROFLO METERS Company. The new company will have offices in Sydney and Melbourne.

Fisher Governor and Electroflo between them produce comprehensive control systems for power stations and the process industries, manufacturing a substantial variety of industrial instruments and control equipment.

In South Australia NEWTON MACLAREN will still represent Electroflo.

American Compacts are Poor Business for Steel

The United States compact car uses some 800 lb less steel than a conventional model. The steel industry of America is now reflecting that while the new cars may have had an effect in livening up the trade, and also in reducing imported car sales, the long term outlook for car demand on steel capacity is not exactly a beneficiary.

Currently the percentage of North American steelmaking capacity in use is below even the figures reached before the threat of the US steel strike began to cause some stockpiling. There are several reasons for fearing that the present low level of demand will continue perhaps well into the autumn.

Even more than British firms, American companies have made vigorous attempts to reduce the amount of stock in hand and the times in which work in progress is going through the factory. This not only means there is less money tied up, or less borrowed, it also means that for the same volume of production there is less steel in the works.

From the nature of the last point it cannot have a permanent effect upon steel consumption, but at the time that more efficient stock control is introduced control is introduced there is normally some easing of material orders.

US Half-Year Fire Losses Up On Last Year

The total estimated value of losses by fire in the United States in the first half of this year is $573,971,000, a $13 million increase over the 1959 half-yearly figure, $560,866,000.

In the opposite direction, the number of fires causing damage of $15,000 or more this June had fallen below the number in May. There were 196 such fires in June, against 209 in May, but the fire losses had risen from just over $19 million to almost £22 million.

June of 1959 was a substantially worse month than this June. Losses then reached a total of $25,367,000.

Oil in the Egyptian Desert?

The discovery of oil in the desert is the dream of every middle eastern government. So far most of them have done very well in this respect. There are exceptions, however, and Egypt is one. With the Libyan discoveries only 225 miles from the Egyptian border interest in the Western desert has revived. The Ministry of Industry of the United Arab Republic, Egyptian Region, is now inviting competitive bids for search concessions in an area of over 400,000 sq. km of desert. The closing date for applications is 15 August.

The terms on which concessions are being offered are interesting, and may affect oil politics elsewhere. They represent a new variation in the 50/50 profit-sharing scheme. When oil is discovered an Arab company must be formed to exploit the field.

Two types of proposals have to be concluded by applicants. In the first the UAR Government has to be offered participation in the company which then pays royalties, rentals and taxes only up to 50 per cent of the profits. In the other no participation has to be offered to the government, but the percentage of profits payable to it would be above 50 per cent. Royalty payments vary for different concession areas but will not be less than 15 per cent for the first 10 years and 25 per cent after that.

The territory involved in this arrangement is bounded by the Nile on the east, the Libyan border on the west, and the 25° line of latitude in the south. It is split into 13 concession areas of 25 to 40 thousand sq. km each. The intention is that not more than one or two concession areas will be granted to any one firm. The timing of the operation may present difficulties. A quarter of each concession area must be given up at the end of the third year, half after the sixth year and only 15 permits will be retainable after the tenth year. What are the prospects in Egypt? Since 1956 when a new law was passed the only concessions granted in the Western desert have been to the US Continental, Ohio Oil, and Amerada companies. No discoveries of oil were reported and the group withdrew two years ago after spending $26·5 million and drilling nine dry holes, of which the most southerly was 250 km from the coast.

Now a number of companies, some of them disappointed at not getting concessions in Libya are taking an interest in the Egyptian offer. It will be interesting to see whether the whole territory will be taken up on the rather stiff terms offered.

A New £10 Million ICI Nylon Plant

IMPERIAL CHEMICAL INDUSTRIES' chemical empire at Wilton, is to have a £10 million extension to its nylon polymer producing capacity.

The present ICI plants were set up for the manufacture of nylon 66 polymer. The extension, capable of turning out 15,000 tons of nylon a year, will produce nylon 6.

Both the plastics industries and textiles are expected to be calling for larger supplies of nylon, hence the decision to expand capacity.

Administrative Offices and a Welsh Bridge

An administrative building at Preston for the United Kingdom Atomic Energy Authority and district offices for the Midlands Electricity Board at Wolverhampton are to be built by the TG CONSTRUCTION Company, a member of the TG TARMAC Group.

Another member of the group, TG CIVIL ENGINEERING Limited, is to build a new bridge at Maentwrog, Merioneth. This will be a three span bridge on two mass abutments and two river piers. Work on the bridge is expected to be completed by the end of the year.

Ghana's Choice of Foreign Advisers

Is there any lesson to be learned from the selection Ghana has made for specialised help when she realises between £15 and £18 million of her reserves for development projects next year?

There has been some talk of an issue of Ghana Government 5 per cent stock. A London stockbroking firm has been asked to assist with advice.

The offer by Western Germany of the services of an experienced individual through whom foreign investors can be reached has also been taken up. The first essential of the Ghana development projects will be the broadening of the economy in the direction of reduced dependence on the cocoa crop, still the basis of Ghana's economic viability.

German Car Output and Exports Rising

West German car output this year is running at a rate more than a fifth higher than at this time twelve months ago.

With the German motor industry association's announcement that 927,024 cars and station wagons were produced up to the end of June this year it appears that the German industry is all set to turn out not far short of two million cars by the year's end.

The exact increase in cars and station wagons is 28 per cent above the same months last year. If all other vehicles are taken into account the increase is one of 26 per cent.

Fifty-one per cent of the vehicles produced this year have been sold abroad, an improvement of 16 per cent over last year's comparable export figures.

Toy Makers Protest at New Japanese Quota

The increased quota of Japanese toys to be allowed into the United Kingdom, £415,000 instead of the old £180,000, has called forth the opposition of the British TOY MANUFACTURING ASSOCIATION.

The Board of Trade are to be asked if the President will receive a delegation to put the British toy makers' case.

Already the Association has explained that with competition in the British home market as keen as it is, increased foreign intervention is bound to cause home manufacturers to divert their efforts from overseas selling to retaining their grip on the United Kingdom home base.

Last year British toy makers sold £8 million worth of their products overseas. 1959's sales by the toy makers, excluding purchase tax were worth £33,006,500, plus a bonus of, £3,870,000 for indoor games.

Agreement on New Atlantic Cable

The POST OFFICE and the AMERICAN TELEPHONE AND TELEGRAPH Company have concluded an agreement for the laying of a new Transatlantic telephone cable to come into use in 1963.

The cable will be the largest ocean cable yet laid, providing 128 circuits between the UK and US and substantially improving telephone communications between the two countries.

Some indication of the demand for the service, and the way in which transatlantic cable facilities generate business, is the fact that the number of calls between Britain and the US is now three and a half times more than when the first transatlantic cable was opened in 1956. The calls are still growing at the rate of some 500 a month.

In the initial stages of operating the new cable, which is to be named TAT 3, some of the circuits will be used to relieve the pressure on the cable between France and the US, opened in 1959. The £12 million TAT 3 project will be a joint enterprise between the Post Office and American Telephone. Unlike the two existing transatlantic cables, which come ashore in Newfoundland, TAT 3 will run from the United Kingdom direct to the United States' shore. Landing points have yet to be settled. It will be 3,400 nautical miles long and will be jointly owned by the Post Office and the US company.

Incorporating about 180 rigid type repeaters, of a new pattern by the BELL TELEPHONE LABORATORIES, the cable will be lightweight, with polyethylene insulation and no external armouring. It is the same type of cable that will be laid between Britain and Canada next year.

Air Compressor Which Releases No Oil

A conventional compressor passes small droplets of lubricating oil into its delivery. This is no good for a deep sea diver breathing from a compressed air line. In this new design oil contamination can be reduced to 0·03 ppm by volume.

By Dr. Ing. L. Kahane

Australian Defence Scientific Service

IN SOME applications of compressed gases it is essential to keep the oil contamination of the gas caused by its passage through the compressor as low as possible. An important example is the provision of compressed breathing air for diving purposes. As commercially available air compressors are generally unsatisfactory for this purpose, the compressor described here was developed for this special application, but it may be used also for compression of gases other than air by incorporating a minor modification.

COMPRESSOR DESCRIPTION

The general features of a reciprocating type piston compressor together with conventional oil lubrication have been retained, but a piston of special shape is used, as shown in Fig. 1. The central portion of the piston is of standard lubricated design, and is surrounded by a cylindrical sleeve separated by small radial gaps h_1 and h_2 from the outer and inner cylinder respectively. The outer cylinder could have had several openings at its lower end; instead, however, one large hole H is provided in an embossed portion, on which an auxiliary cam-actuated valve was mounted initially for experimental purposes. As the operation of this valve did not produce any observable change of performance on preliminary tests, the whole valve assembly was later removed leaving the hole open in the outer cylinder wall. The experimental compressor has cam-operated poppet inlet and outlet valves, with the stems sliding in molybdenum-disulphide coated bushes to eliminate the need for oil lubrication.

This arrangement utilises the pressure seal effect created between the smooth cylindrical surfaces of piston sleeve and outer cylinder, caused by the viscous drag of the air in the narrow radial gap h_1; this is kept as small as possible and constitutes the piston seal. The same effect also occurs in the gap h_2 but is less important here as it has no direct influence on the performance. D therefore represents the effective piston diameter, and there is no lubricant at all in the effective cylinder space.

During the compression stroke the pressure gradient along the sleeve causes some loss of air through the seal, which escapes through the opening H. During the suction stroke the pressure gradient is reversed, but is of much smaller magnitude, and so the amount of air entering the cylinder space through the seal is negligible.

The inherent imperfection of the seal to obtain minimum oil contamination has two consequences. Firstly, some loss of efficiency must be accepted, with a corresponding sacrifice of optimum performance. Secondly, the use of the compressor, as described, for gases other than air is limited to cases where the loss of gas can be tolerated economically, and where the leaking gas is neither poisonous nor objectionable.

These disadvantages can be overcome to a great extent by omitting any opening in the outer cylinder. Gas lost through the seal cannot then escape, and pressure will build up at the underside of the sleeve until a state of equilibrium is reached at which equal masses of gas oscillate between the spaces at each end of the sleeve. This improves the performance by increasing the pressure produced at a given speed. However, oil-contaminated gas can now enter the cylinder space through the seal and diminish its final purity to some extent.

The compressor can be provided with a manually adjustable valve connected to the opening H. A fully open valve will give maximum purity while a fully closed valve will give maximum performance, and in other valve positions intermediate values are obtainable.

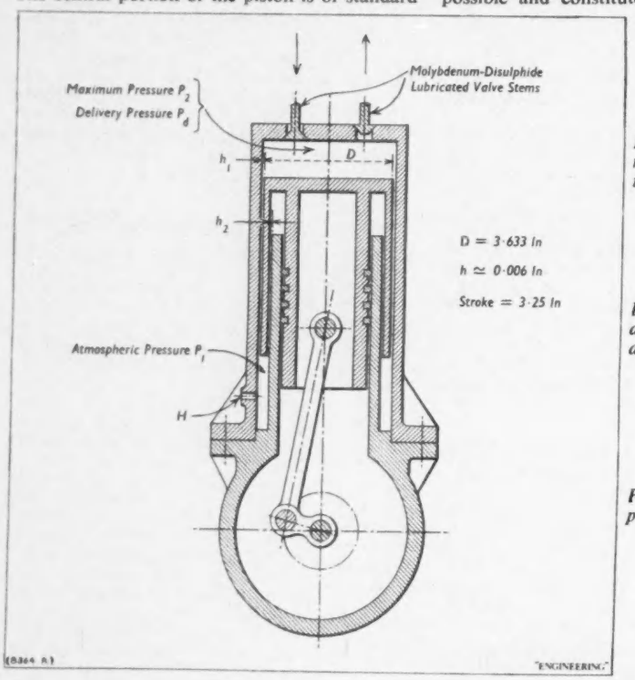


Fig. 1 (left) Diagrammatic layout of experimental single stage compressor.

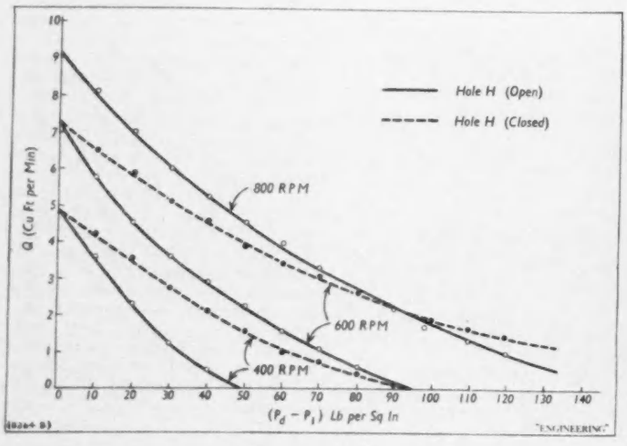


Fig. 2 (lower left) Free air delivered per minute as a function of gauge pressure.

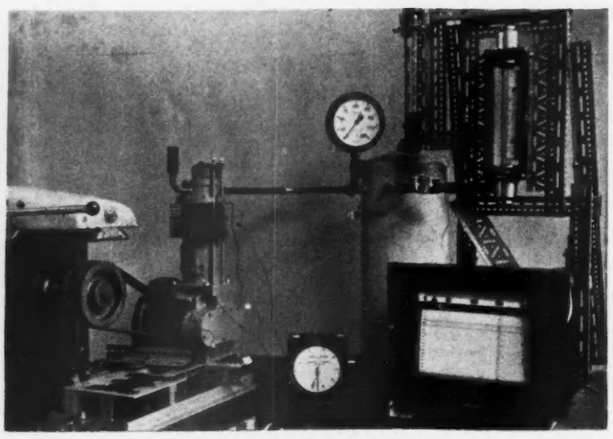


Fig. 3 (lower right) Compressor set up for mechanical test.

TEST RESULTS

Oil Contamination.—Such contamination is defined here as the increase in oil content of a gas resulting from its passage through the compressor.

With the hole H open, the average oil contamination was 0·03 p.p.m. by volume. The corresponding figure for a conventional air compressor of comparable capacity and pressure when tested under similar conditions was 3 p.p.m.

To allow for the possibility of the greatly improved result given by the special compressor being due (in part at least) to better piston ring sealing, the following additional comparative

tests were made on the special compressor:
(1) With the hole H closed but otherwise unchanged.
(2) Converted to simulate a conventional compressor, i.e., the piston sleeve was removed and the inner cylinder extended upwards by means of a press-fitted spigoted tube to meet the cylinder head.

In the first of these tests the contamination was 0·35 p.p.m. and in the second 0·9 p.p.m.

Consideration of the above results suggests that the special features of the new compressor taken together are responsible for a reduction in oil contamination conservatively estimated at 30 to 1.

In course of the tests, very striking visual evidence was obtained of the low oil content of the air being delivered by the compressor. On each occasion when the cylinder head was removed, all the surfaces exposed in the effective cylinder space were entirely devoid of oil, even after many hours running; steel parts even showed a tendency to rust.

Mechanical Performance.—Under this heading only the delivered volume of free air Q as a function of the gauge pressure ($p_d - p_1$) will be considered here. This relationship was experimentally determined for a number of speeds with the hole H open as well as closed. Some results obtained are given in Fig. 2. Calculated curves (not shown) give good agreement with experimental ones, considering the simplifying assumptions which were made in the theoretical analysis. Fig. 3 shows the compressor set up for the mechanical tests.

CONCLUSIONS

A novel compressor has been developed with the sole aim of keeping oil contamination to a minimum. In this respect a considerable improvement has been achieved while retaining an acceptable mechanical performance. Further improvement may be possible and in this connection two points may be mentioned.

The volume of gas lost through the seal is proportional to h. On the experimental compressor, h_1 cannot be reduced below a certain critical value at which rubbing starts to occur between sleeve and cylinder wall, caused by tilting of the piston induced by the lateral component of connecting rod thrust. The use of a piston rod and guided crosshead would allow a safe decrease of h_1, resulting in better performance.

Also there is the possibility of further improving the piston seal by providing circumferential grooves in the sleeve and/or the cylinder wall. Development work along these lines might be well worth while.

Although no experimental study has been made of the effect of the condition of the piston rings on the air purity, the principle of operation of the compressor suggests that this is not likely to be seriously affected by the amount of oil leaking past the piston rings.

Acknowledgment.—This paper is published by permission of the Chief Scientist, Australian Defence Scientific Service, Department of Supply, Melbourne, Australia.

Miniaturised Pitch and Roll Indication for Aircraft

A miniaturised pitch and roll indicating system, intended as a standby unit to replace an aircraft's primary pictorial indicator in the event of failure, has recently been developed. The miniature indicator is the smallest yet built for the aircraft industry, and despite its reduced size and power requirements, it provides all the information found on the primary indicator. In appearance the new 2 in pictorial indicator is a scaled down version of the Lear standard 5 in model.

The miniature indicator displays pitch and roll attitude by movement of a light grey and optical black sphere behind a symbolic aircraft scribed on a fixed transparent mask. A $1\frac{1}{2}:1$ gearing in the pitch axis provides increased sensitivity of the pitch attitude for maximum readability. Electrical trim for both pitch and roll is included.

The indicator is hermetically sealed and includes two very small transistor amplifiers. The servo loops are 70 per cent critically damped for smooth, sensitive operation, and the two amplifier modules are identical and interchangeable. The heart of the system is a compact vertical reference designed to provide reliable operation in severe shock and vibration environments. The gyro reference is mounted remotely from the indicator package to provide a gyro of sufficient size to maintain the accuracy of the primary system.

The new miniature model can be operated from either an a.c. or a d.c. power supply, and is available from Lear Incorporated, 19 Rue de Rhône, Geneva, Switzerland.

Head Correction Factors for Radial Impellers

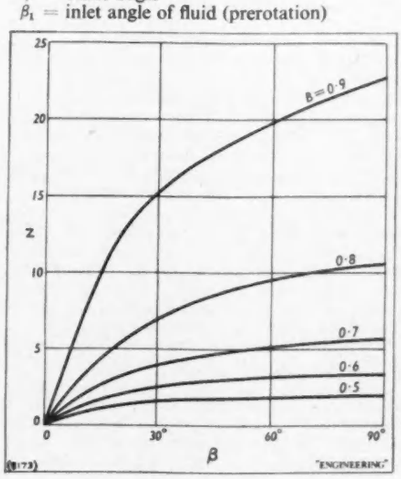
By G. T. Csanady, University of New South Wales

Is it shown by Wislicenus,[1] on the basis of the work of Busemann, that the head developed in a radial impeller with logarithmic spiral blades is (theoretically):

$$gH = BU^2 - \frac{CUQ}{\pi Db}(\cot\beta - \cot\beta_1) \quad (1)$$

where

g = acceleration under gravity (32·2 ft per sec per sec)
H = head of fluid flowing in feet
B = zero flow correction
U = peripheral speed of impeller in ft per sec
C = Weinig factor
Q = flow rate in cusecs
D = impeller diameter in ft
b = impeller width at exit in ft
β = blade angle
β_1 = inlet angle of fluid (prerotation)



The factors B and C are presented by Wislicenus in a number of charts as functions of blade angle β, ratio of outlet to inlet diameter D/D_i and number of blades Z. (The inlet diameter D_i is measured at the inlet edge of the radial blades; this measurement often has to be some kind of mean.)

On examination of these diagrams it becomes clear that the diameter ratio has no further effect when:

$$\frac{D}{D_i} \geqslant e^{\frac{2\pi}{Z}\sin\beta} \quad . \quad . \quad (2)$$

The limit corresponds to an "equivalent" spacing to chord ratio = 1·0 of the flat plate cascade which may be obtained by conformal mapping from the log-spiral radial cascade.

Diameter ratios in excess of the limit may be considered "large" and from the point of view of fluid deflection in the tangential direction it is senseless to increase the diameter ratio beyond the limit (although it may be necessary to do so to ensure smooth inlet flow). For a centrifugal pump, for example, with eight blades and a blade angle of 25°, the limit turns out to be $D/D_i = 1{\cdot}4$, so that the inner diameter may well be as large as 70 per cent of the external radius without reducing output.

In practice the diameter ratio D/D_i is usually greater than the limit. In that case the presentation of the factors B and C becomes a good deal simpler; one may take C = 1, B as a function of the number of blades and the blade angle from the accompanying graph.

As an example consider the pump impeller tested by Acosta and Bowerman.[2] Relevant data were:

Diameter ratio $D/D_i = 1{\cdot}9$
Outlet blade angle $\beta = 17°$
Number of blades $Z = 5$

The limit by equation (2) becomes:

$$e^{\frac{2\pi}{Z}\sin\beta} = 1{\cdot}45$$

so that the diameter ratio may be regarded large. Then from the illustration:

$$B = 0{\cdot}8$$

Hence, if the flow coefficient is introduced:

$$\phi = \frac{C_{ar}}{U} = \frac{Q}{\pi DbU}$$

the head-volume characteristic becomes:

$$\frac{gH}{U^2} = B - (\cot\beta)\,\phi = 0{\cdot}8 - 3{\cdot}27\phi$$

(there was no prerotation, i.e. $\beta_1 = 90°$)

This result agrees with the "theoretical" curve displayed by Acosta and Bowerman (obtained by the use of the fuller charts) and is, in the optimum range, only a few per cent below the measured characteristic. That the measured head is slightly higher than the theoretical head could perhaps be attributed to the constriction caused by the finite thickness of blades plus their boundary layers; the resultant increased velocities mean increased pressure differences on the blades.

It should be noted that these results are valid for an isolated impeller; volute losses usually change the characteristic curve considerably, but allowance for such losses may be made in a separate calculation.

REFERENCES

[1] Wislicenus, G. F., *Fluid Mechanics of Turbomachinery*, McGraw-Hill, 1947.
[2] Acosta, A. J., and Bowerman, R. D., *Trans. ASME*, 1957, No. 79, p. 1821.

French Aviation Rises with the Caravelle

The Caravelle is now a familiar sight at London Airport, but it can hardly be a welcome one to British aircraft makers. The Douglas-Sud-Aviation agreement represents one of the biggest challenges the industry has yet faced.

By Richard Bailey

THE aircraft industry has been one of the big successes of French post-war economic development. Anyone spending half an hour at London Airport will see at least one Caravelle on the tarmac and probably more. France is in the big league of aircraft manufacturers. Yet only a few years ago Sud-Aviation, makers of Caravelle, were frantically turning out gas-generating engines in the hope of staving off bankruptcy. How has this change come about and what sort of a challenge does it represent for Britain's aircraft industry?

The aircraft industry in France consists of some 250 firms of all kinds with around 85,000 employees. The bulk of its engine and airframe activities, however, are concentrated in the hands of 18 companies. Of these, three of the biggest—SNECMA (aero engines), Nord-Aviation and Sud-Aviation (airframes) are nationalised. The private sector still contains some major companies, however, including Bredguet, Dassault, Potez Air Fouga, Hurel Dubois, and Morane Saulnier all making airframes, and Hispano Suiza and Turbomecca making engines. In the past the industry has collaborated with British aircraft manufacturers in various ways. The de Havilland Vampire and Sea Venom have been built under licence in France. Many British engines and components are used in French aircraft.

LINKS WITH THE USA

There is little doubt that the French aircraft industry has lately been drawing away from collaboration with Britain and closer to Continental and American producers. The most important agreement of this kind is that between Douglas Aircraft Company and Sud-Aviation concluded in February, under which Caravelles will be manufactured under licence by Douglas in the United States. The deal is a very important one for France, and it may also have considerable repercussions on British aviation.

An article in the French business weekly *Entreprise*, commenting on the Sud-Aviation-Douglas agreement, began with the words "Les Anglais sont furieux," and went on to say that the British makers had only themselves to blame at being left out of Continental moves.

Considering that it was out of action at the end of the war, French aviation has jumped ahead. How has this come about in the case of the principal company Sud-Aviation? The starting point was the appointment of Monsieur Georges Héreil as its chairman in 1946. Since then he has built up "le style Sud" as a force not only in French, but world aviation circles. He began by buying the licence to manufacture the British Vampire in France. It was from the Vampire that the Mistral was developed. Later the Mystère series of jet fighters was built by Sud-Aviation for Marcel Dassault. Other Sud products were the Trident rocket-interceptor, the Vautour twin-jet bomber and the Alouette and DJINN jet helicopters.

But it is in the field of commercial aircraft that M. Héreil has provided the biggest impact. He believed that there was a big opening for French aviation in the development of commercial jets. When the Vickers Viscount dominated the market for medium range airliners Héreil was convinced that, although dearer to build, jets could profitably be used on medium distance runs as well as on the North Atlantic. The starting point was to design an aircraft that could make ten or twelve flights over distances of around 200 miles in the course of a day. Caravelle Number One was in the air in May, 1955, and the first production models came off the assembly lines in May, 1958. Its reception in France was mixed. The engineers admired its line and performance, but the big question remained, "could it be sold?" The answer is that about 100 have been sold of the 200 sales that had to be made to cover costs, and with orders still coming in it now looks certain that the Caravelle gamble has come off. It has made Sud-Aviation a big civil aircraft producer on a world scale, alongside the big American and British firms.

Launching the Caravelle on the European market was undoubtedly a risky business. Although a key market, Western Europe represents only about a fifth of the world market. In working out the operational snags and putting the Caravelle across, the engineering staff of Air France played a considerable part. So did the order received from SAS, the Scandinavian combine, which made the aircraft more widely known, but the biggest test was whether the Caravelle would sell in the United States.

Facts about Sud-Aviation

The sixth aircraft company in the world
22,000 workers
1,500 engineers
8,500 machine tools
8 factories: Toulouse, Marignane, Bouguenais, La Courneuve, Saint Nazaire, Rochefort, Courbevoie-Suresnes, Cannes
4 research centres.
82 per cent of its factory space devoted to the Caravelle
67 per cent of hours worked devoted to the Caravelle

With the American engineers in mind, the drawing office at Sud-Aviation had prepared plans that accorded with United States practice, and the prototype was built to conform with American rather than French operational standards. It would be interesting to know if any British firms have ever carried out the opposite task of working out plans entirely on the metric system for the continental market.

In 1956 Sud-Aviation opened an office in New York with M. Claude Teyssier in charge. A great effort was made to put over the Caravelle to the American public. Some sixty demonstrations were given by the prototype at airports throughout the continent, during which it flew over 26,000 miles. And as a result of all this activity Sud-Aviation sold—not a single Caravelle. No one, either in North or South America, was prepared to buy on the evidence of successful demonstrations by a prototype.

For the breakthrough into the American market, a guarantee was required from a leading United States constructor whose judgment would be accepted and trusted by the airlines. Sud-Aviation already had a close commercial relationship with the Republic Aviation Corporation which marketed the Alouette helicopter in the United States. However, Republic was essentially a maker of military aircraft, so it was decided that only a tie-up with a big commercial maker would do. Thus the agreement with the Douglas Aircraft Corporation was negotiated.

In the event, this agreement proved to be almost as important to Douglas as to Sud-Aviation. The American company wanted to add a medium jet airliner of the type of the Caravelle to its range. The link with Sud-Aviation therefore saved Douglas a major investment of anything up to $200 million, and enabled it to sell a proved aircraft rather than starting off with a prototype. The DC9 will merely remain a gleam in its designer's eye.

The commercial and manufacturing side of the agreement are now being put into operation. A depot for aircraft parts made in France has been built by Douglas and a training school for technicians set up. This will concentrate on turning out engineers and mechanics who understand every aspect of the mechanism and the operation of the Caravelle. After-sales service of a very high order is promised. Following the delivery of an aircraft a team of six or eight specialists will be attached to the operating company. Full details of every aspect of the performance of the aircraft will be recorded on punch cards and sent by Telex for examination by the research staff. The life-history of every Caravelle is scrutinised at Suresnes, where the staff includes 70 highly trained engineers.

All this adds up to a considerable achievement for French aviation, and a further move in the broad attack which US aircraft companies are making on European aviation. Its jet airlines—the Boeing 707, DC8 and Convair Coronado—have been ordered by many European operators. The strong challenge to British aviation this represented was one of the reasons for the concentrations in the industry earlier in the year. Various ties have been established with European aviation in the past few years, but the number of joint projects is still very small, and those that exist are not on anything like a sufficiently large scale. The Douglas—Sud-Aviation agreement may very well raise considerable difficulties for British manufacturers in the European and American markets. The French recognise this and say that we have only ourselves to blame. They claim that British manufacturers have repulsed all offers of collaboration, and that government policy has put up a "Keep Out" sign around the Sterling area. If Britain is hurt by what Sud-Aviation has done, blame lies with our policy of "splendide isolement."

Whether this French viewpoint does justice to the British aircraft industry or not is open to argument. But unless the industry can snap out of its apparent complacency and begin to think in terms appropriate to the jet age in design, marketing and collaboration with manufacturers abroad, its prospects are not bright.

Electronics Inject New Life into Medicine

Electronic techniques are the lifeblood of modern communications. They are also vital to nearly every branch of industry and to all modern military activities. Now they have become established in the world of medicine.

THE world's first comprehensive exhibition on medical electronics was held at Olympia, London, last week. It was run jointly with the Third International Conference on Medical Electronics, which was held under the auspices of the Institution of Electrical Engineers.

The significance of electronics in medicine is twofold. It has become an indispensable tool for the medical practitioner and surgeon, leading to improved techniques of diagnosis, therapy, medical research, surgery, and so on. At the same time it has become a new branch of industry, wherein new firms are establishing themselves, and in which Britain is showing signs of world leadership.

In opening the conference, Sir Willis Jackson, President of the IEE, said that medicine was being allied with electronics because it provided "precise analytical treatment and measuring tools of amazing ingenuity and scope." That this is true was more than adequately confirmed by the wide range of electronic machinery on show in the exhibition. These exhibits ranged in size from large-scale X-ray apparatus right down to a microminiature radio transmitter, so small that it can be swallowed like a pill. Between them, these instruments and apparatus make use of almost every technological innovation that electronics has brought into the fields of engineering and science.

Instrumentation is becoming increasingly important to all medical and biological workers. In this respect, electronics provides the most accurate, speedy and convenient means of measuring small electric changes and amplifying them. These electrical changes may result directly from the actions of the nerves or heart, or they may be translations of other bodily functions such as breathing, temperature, blood flow, etc.

CONTROLLING THE BODY

In addition, electronics can supply a permanent recording of biological changes, and from here it is a logical step to control such changes. For instance, if the heart rate is being recorded, the output could be made to trigger an electronic stimulator if the rate should fall. Similar control methods could be applied to circulation, breathing and the nervous system.

Electronic instrumentation can also contribute much in the field of preventative medicine. Diseases like bronchitis and lung cancer have proved relatively intractable, but nevertheless affect large sections of the population. It is possible that they are due to different habits or daily environment between different members of the population, in which case statistical information would be needed on the habits and living conditions of large numbers of people. Since healthy people have far more objection to wearing a recording instrument than those who are undergoing medical treatment, it is in the design of an acceptable and unobtrusive instrument for normal people to wear that electronics may be able to make a large contribution.

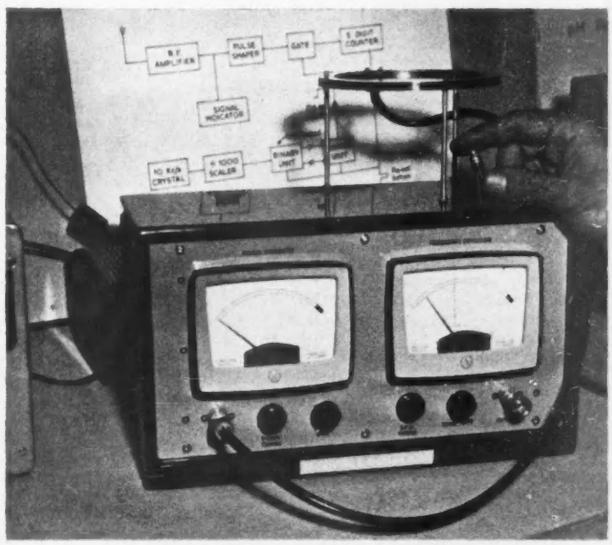
The human body is made up of a number of inter-related systems—brains and nerves, heart and blood vessels, stomach and intestines, lungs and windpipe—and different electronic techniques can be used for their measurement and control.

In the respiratory system for instance, one of the things that the physician may need to know is the velocity at which air flows through the windpipe and the volume of air taken at each breath. This may be measured by a device called a pneumotachometer. In this, the airstream passes through a piece of metal gauze, causing a change in pressure which is related to the rate of flow. The change in pressure is extremely small, but it can be measured by an electronic pressure gauge. The electrical signal obtained is passed through a "black box" which then instantaneously computes the volume of air breathed in a given time, and puts a permanent record on a continuously flowing chart.

Another requirement of the physician may be to know the amount of carbon dioxide which is being excreted as a waste product in expired air. This information can, of course, be obtained by classical chemical analysis, but a single determination would take a skilled technician half an hour or more. An electronic method makes use of infra red rays which are passed through a sample of the breath, giving a direct reading of the amount of radiation absorbed by the carbon dioxide, and by this means, the required analysis can be made in a few hundredths of a second.

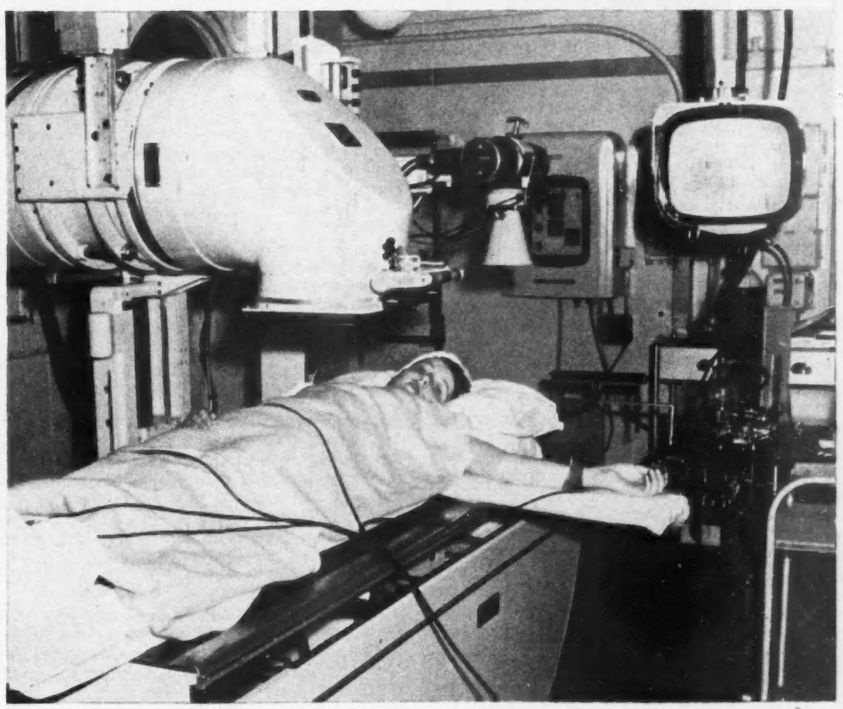
AUTOMATIC ANAESTHETICS

In poliomyelitis the breathing muscles may be partly paralysed, so that the patient's respiration must be machine assisted if he is to remain alive. Electronic techniques have now been developed to automatically measure the patient's degree of disability and control the lung machine accordingly. The same technique may be used



(Right) A "radio-pill," that can be swallowed by a patient, transmits information about conditions inside the body.

(Below) The Marconi X-ray image intensifier being used for cardiac catheterisation, at the King Edward VII Memorial Hospital.



Spark Eroded Surface Characteristics

Spark erosion is becoming widely used as a technique for metal working, particularly when hard metals or complex shapes are involved. However, not enough is yet known of the surface finish properties of the technique.

By S. R. Ghabrial, Ph.D., B.Sc.(Eng)

IN THE spark-erosion process, metal is removed by the action of electrical spark discharges which are produced in a gap between the tool-electrode and the workpiece. Any desired shape may be imparted to the workpiece by a suitably designed electrode. The cutting electrode and the workpiece are immersed in a suitable dielectric.

Due to the slow rates of spark-machining, as compared with conventional methods, the process is mainly used for hard materials such as nimonic, hardened steels and cemented carbides; it is, however, also used for cutting complicated shapes in soft materials. The process is suitable for the machining or the servicing of forging dies, extrusion and drawing dies and of die-casting moulds.

INVESTIGATING THE CHARACTERISTICS

A number of articles[1, 2, 3, 4, 5, 6] have already dealt with the underlying principles and possible applications of the process. However, the object of the authors' investigation has been to examine some characteristics of spark-eroded surfaces for the purpose of:

(*a*) Assessing the amount of hand or machine correction, if necessary, to impart to the previously spark-eroded surface the degree of finish which is required for the intended purpose.

(*b*) Furnishing data for the polishing of dies and moulds after spark machining.

The scope of this investigation has covered the following:

(*a*) Relations between surface finish parameters, namely: centre-line average, "CLA" value; maximal depth, "R max"; and depth of smoothness, "G."

(*b*) Relations between wear and surface finish.

(*c*) Relations between the polishing depth of a crater-free sub-surface and surface finish.

PRACTICAL TESTS

The spark-erosion machine used in the present investigation was a 2 kW capacity GKN spark machine, designed by the Guest, Keen and Nettlefolds Group Research Laboratory.

Four sizes of condenser are fitted, any of which can be selected by means of a four-way switch as follows:

Rough finish	Position 4	1 μF condenser
Semi-rough finish	Position 3	0·5 μF condenser
Semi-fine finish	Position 2	0·25 μF condenser
Fine finish	Position 1	0·1 μF condenser
Average working voltage		125 volts
Average open-circuit voltage		230 volts

Paraffin was used as the dielectric and fed through the gap under pressure. The rate of flow was about 20 cc per min.

Various rates of erosion of the specimens, ranging from 30 to 0·5 cu. mm per min, were used as follows:

Machine setting	4-14	4-12	4-10	4-8	4-6	4-4	4-2	3-10	3-8	
Rate of erosion	30	25·6	17	11·5	7·1	5	1·7	11·5	8·5	
Machine setting	3-6	3-4	3-2	2-10	2-8	2-6	2-4	2-2	1-8	1-6	1-4	1-2
Rate of erosion	5·7	3·4	1·7	10	5·7	3·6	2	1	3·4	2	1·2	0·5

In order to facilitate the lapping work later required, mild steel was chosen for the specimens.

Diameter of spark-eroded surface ..	1$\frac{1}{2}$ in
Diameter of the hole for forced flow	$\frac{1}{4}$ in

The electrodes were made from brass bars having the same size as the specimens.

Surface Finish Values

In order to identify the surfaces accurately, more than one parameter was determined. The CLA was measured with both a Talysurf and a Perth-o-Meter, while the maximal depth (R max) and depth of smoothness (G) could only be measured with the Perth-o-Meter.

From the results, the ratio Rmax/CLA is about 5·2 $\pm$ 15 per cent. This ratio is higher than the average value for turned surfaces (4·5[7]) and smaller than that for ground surfaces (6·7[7]).

It should be remembered that the spark eroded surface is a non-directional one. The ratio R max/CLA serves only to give an approximate idea about the penetration of spark action. It can be useful when considering the dimensional change that will result from removing the majority of the crater texture by lapping.

The ratio of depth of smoothness to CLA is about 2·1 $\pm$ 10 per cent. This ratio is smaller than those for most conventional machining methods, the values for which are quoted[8] as follows:

G/CLA	*R max/CLA*	
2-3·1	4·4	Bauer
3	5·9	Pesante
2·8-2·5	6·33-4·58	Nicolau
—	5-2	Schlesinger
—	8·6-4·5	Rubert[7]

Wear and Surface Finish

The spark eroded specimens were carefully lapped in many steps. A Sigma Comparator was used for measuring the depth of the removed layer. The comparator readings were in fair agreement with the decrease in the average values of R max.

Typical records showing the improvement of the surface finish (especially regarding bearing area) with progressive wear, are shown in Fig. 1.

Typical graphs showing the relations between the amount of wear (or depth of lapping) and

continued on next page

Concluding **Electronics Inject New Life into Medicine**

during the critical stages of anaesthesia, where certain drugs may be used which cause temporary paralysis of the breathing muscles.

Even the critical job of *applying* anaesthetics is now being taken over by electronics. A system known as a "servo-anaesthetiser" has been devised which measures the activity of the patients' brain and then uses this data to automatically adjust the application of anaesthetic.

Electronics in industry has given rise to a number of devices which can readily be adapted to medical science. One of the latest of these is the radio pill, which is an application of the electronic transducer technique now used in several fields of industrial research.

RADIO PILL

The radio pill is a sub-miniature, ecapsulated radio frequency transducer, oscillating at a nominal frequency of 400 kc/s. This frequency can be made to vary as a function of the medical parameter being investigated. The pill (16 mm long and 6 mm in diameter) is swallowed by the patient and as it proceeds through the body it translates information about its physical environment into electrical signals. These signals can then be picked up at a distance of up to ten feet from the pill and interpreted into useful medical data. This new device enables important measurements to be made which were not previously possible by any other means.

Best known, and possibly still the most valuable, of all electro-medical techniques is that of X-ray examination. However, this technique does have its limitations, not the least of which is the danger to patients of over exposure to the harmful, high energy rays. Two new techniques have now emerged which will alleviate this difficulty; one is an image amplifier, used in conjunction with normal X-ray apparatus, and the other is a completely new technique in which ultrasonic radiation is used instead of X-radiation.

By using television techniques, the X-ray image amplifier enables a clearer, bigger picture to be obtained and, at the same time, can reduce the X-ray dosage to the patient by a factor of 25. This important reduction in dosage is made possible by "flashing" the patient with X-rays for only a fraction of a second. The image formed is then held electronically on a cathode ray tube and can remain visible for as long as required. In addition to this, by flashing the patient at a slow repetition rate, a stroboscopic, slow motion view of moving body parts can be obtained.

ULTRASONIC "X-RAY"

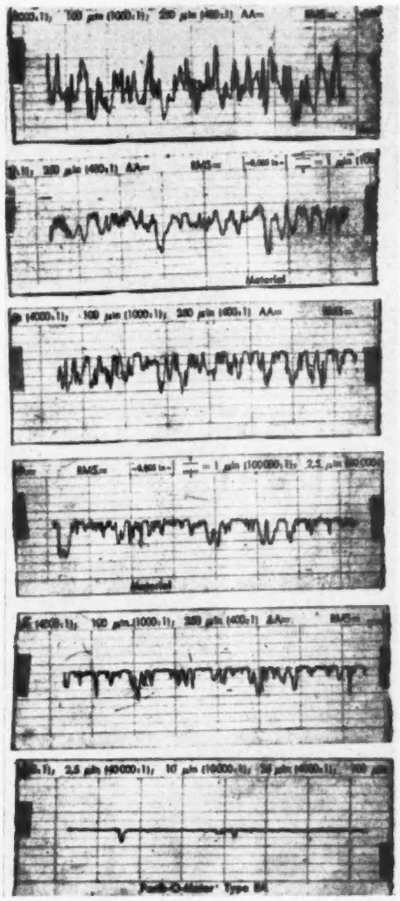
The ultra-sound image camera uses very high frequency sound waves instead of the much higher frequency, electromagnetic waves of X-rays. Although still in a development stage, the ultra-sound camera has already proved its potentialities, both for medical and industrial applications. For instance it has been used successfully for the examination of various welding techniques as well as for medical research.

The principle of the ultra-sound camera is, broadly, the same as that of the television camera but, instead of detecting light waves, it responds to very high frequency sound waves (in the region of 4 Mc/s).

As the sound waves pass through the subject to be photographed they are absorbed in varying degree by matter with various densities. For example, the difference in density between bone and flesh will produce a picture of the internal structure of limb, similar to that given by X-rays.

Of course, ultra-sonic vibrations can be destructive; in fact powerful ones are sometimes used to destroy bacteria, in which case they can destroy body tissue as well. However, the amount of power needed to operate the ultra-sound camera is so low that it is completely harmless biologically.

Many other examples of the application of electronics to medicine were shown at the exhibition, including a heart-lung machine, an electronic stethoscope, radio-active isotopes, apparatus for space-travel research, hearing aids, and others.



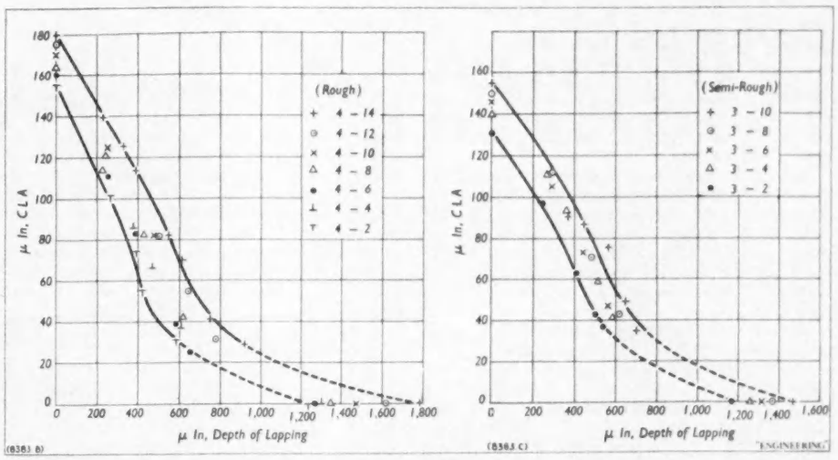


Fig. 1 (left) Typical records of the improvement of the surface finish with wear.

Figs. 2 and 3 (above) These graphs show the relationship between the amount of wear (or depth of lapping) and improvement in the centre line average (CLA).

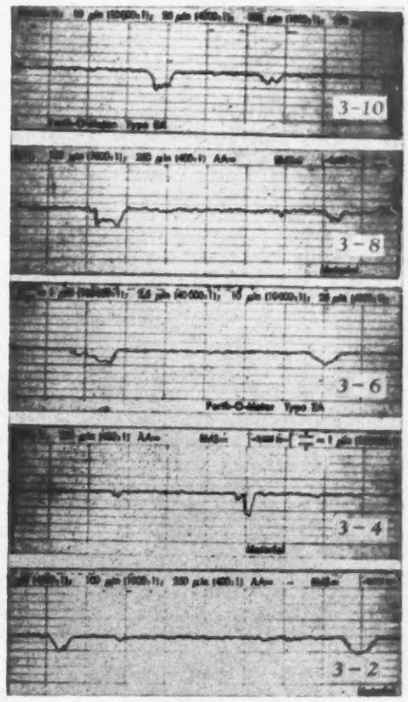


Fig. 4 (right) Deep cavities showing groups of overlapping craters and suggesting the existence of of preferred spark channels.

improvement in the CLA are shown in Figs. 2 and 3. From such relations, it is possible to determine the depth of polishing needed if a certain surface finish is required.

Free Polishing Depth and Surface Finish

Further measurements of CLA, R max and G were taken as long as the surface was still covered with craters, lapping was continued until only few cavities could be spotted (Fig. 4). These cavities showed in most cases a group of overlapping craters. This would suggest the existence of preferred groups of spark channels where conditions were more favourable for successive spark discharges.

The specimens were finally lapped until all cavities disappeared and the surface became free from craters.

IMPORTANCE OF FREE POLISHING DEPTH

Fig. 5 shows the relation between the free polishing depth and the surface finish CLA value at various settings of the machine. The polishing depth decreased as the surface finish improved and as the rate of erosion decreased. The polishing depth is about ten times the CLA value for the machine settings giving maximum rates of erosion without arcing, and it is seven to eight times the CLA value at the minimum rates of erosion.

According to the findings of Barash,[6] the depth of the residual stress sub-surface layer is also proportional to the CLA value (for mild steel, high speed steel and hard steel spark-eroded specimens). In some cases, it was as big as ten times the CLA value.

It seems, therefore, that the free polishing depth is important not only for certain operational functions, but also in cases where residual stresses are to be removed. However, this conclusion should await more extensive research work, especially on hardened steels, so that the results could be directly applied to the polishing of dies and moulds.

The determination of the free polishing depth may also be important in a comparative study into the effect of deep craters and machining marks upon the endurance limit.

Fig. 5 shows also the relation between the free polishing depth and the maximum depth R max. (The values of R max. are the highest values read by the Perth-o-Meter and not their averages.) The relation is linear and the ratio is roughly 1·5. This may be explained as follows:
(*a*) The stylus does not penetrate into the deepest crater.
(*b*) For sampling lengths containing only one very deep groove or non-periodically re-occurring cavities, the pointer does not register the full maximum depth.
(*c*) Any errors of form which may occur in the specimens.

Acknowledgements

The investigation described in the paper was carried out in the Royce Laboratory of the Manchester College of Science and Technology on a Spark Erosion Machine loaned to the College by the GKN Group Research Laboratory, and at the works of Rubert and Company Limited, Cheadle. The author wishes to thank Dr. F. Koenigsberger, Dr. J. Parker, Dr. M. M. Barash and Mr. M. Rubert for their help.

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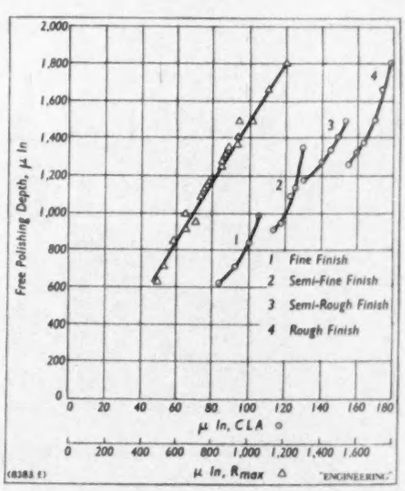


Fig. 5 The relationship between the free polishing depth and the surface finish values are shown on this graph.

Camp de Luxe

A TRAILER tent for sleeping six adults, complete with its own store cupboard and a veranda could take camping into the realms of luxury. And it's so simple.

Behind the car, the tent shown in the accompanying illustrations makes a rectangular block measuring approximately 6 ft 6 in high, 7 ft 6 in long and 4 ft wide. It runs on two pivoted castor wheels at the rear and rides the car coupling at the front. It is called the Accordium, and was shown at the 1960 Mobile Home Show in Indiana, USA.

The Accordium consists of seven rib structures of aluminium channel 6 in wide, joined together by a skin of translucent laminated vinyl and nylon mesh sheeting. On arrival at the camping site, it is unhitched from the car and the front end rested on the ground. The rear is fanned open, using the castor wheels to take the load, until a half circle is formed. The wheels are then screwed clear so that the structure rests firmly on the ground. The next operation is to lift the two side panels (now at the front of the semicircle) revealing a store cupboard and a doorway under each. Supported on poles, the raised flaps form the roof for the veranda and a weather protection for the entrances.

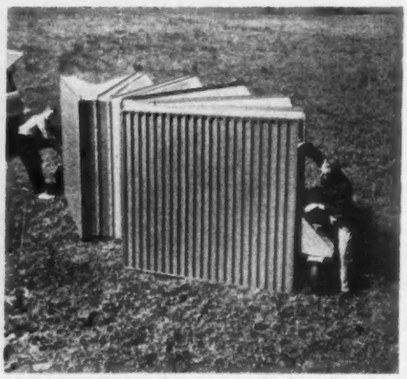
Inside, the Accordium offers six wedge-shaped sleeping spaces, each large enough for an adult. At the head end they are 3 ft wide. The illustration of the interior shows it as an open-plan arrangement, but there is provision for privacy partitions to be fixed to each of the ribs of the aluminium frame. The partitions are also used for the storage of the bedding. Each section has two triangular windows so the interior is quite well lit, especially as the skin is, in any case, translucent. Hanging between the roof channel and the floor are bars for coat hangers—an unusual comfort in a tent, where stowage for clothes is often noticeable by its absence. For ventilation, there are aluminium ventilation flaps built into each section of the plastic wall, which cover permanently screened porthole vents.

Another convenient feature is that the floor is also made of vinyl sheet so that damp is prevented and there is no loose groundsheet to be lost or mislaid. In fact, the Accordium must be almost weatherproof. There are actually doors to the entrances.

One of the storage spaces under the side panels is occupied by two benches that hinge down into position with a hinge-down table between them. Behind the table are shelves for smaller items. The space on the other side has storage compartments for camping and cooking supplies and all the staple necessities that have to be carried around on these occasions. The benches and table will seat all six people at one time.

The designer of the Accordium is Mr. Henry Glass of the Chicago consulting designers of that name, and it is an addition to the Forecast range of items made by the Aluminium Company of America, whose head office is at 1501 Alcoa Building, Pittsburgh 19, Pa., USA.

A compact box towed behind a car . . . .



. . . . fans out to form a luxury tent with . . . .

. . . . a covered forecourt, seats and table.

Six adults can sleep in the Accordium.

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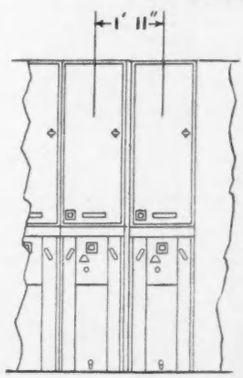

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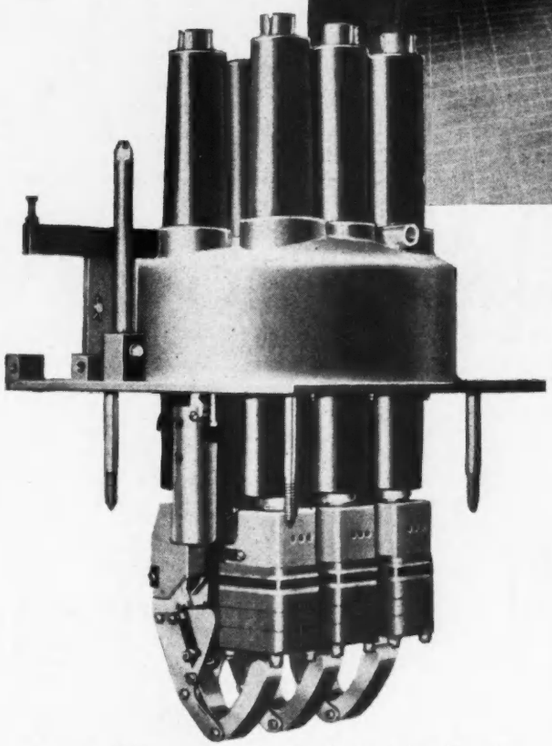

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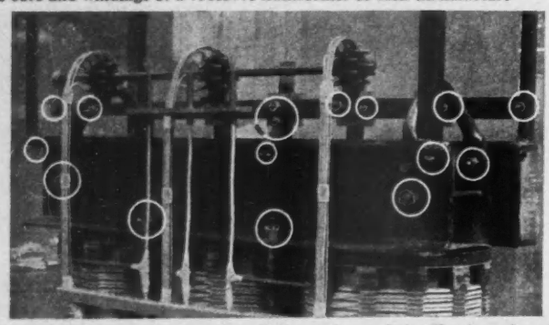

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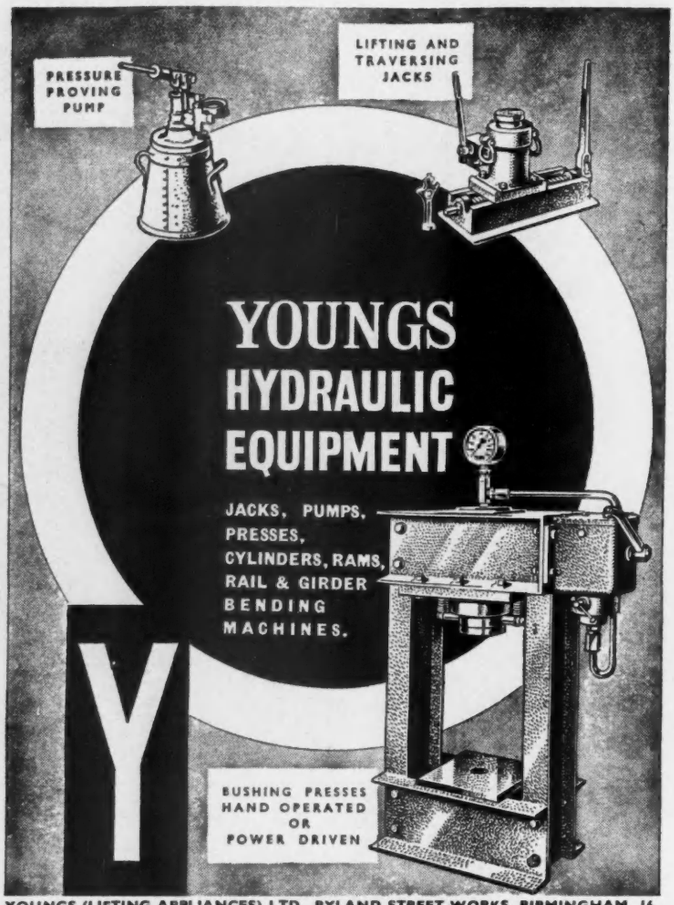

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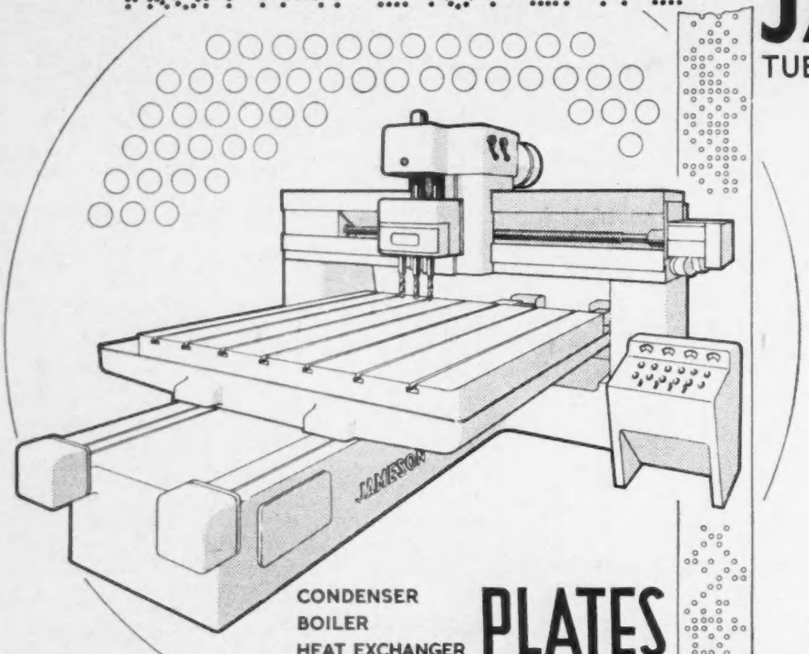

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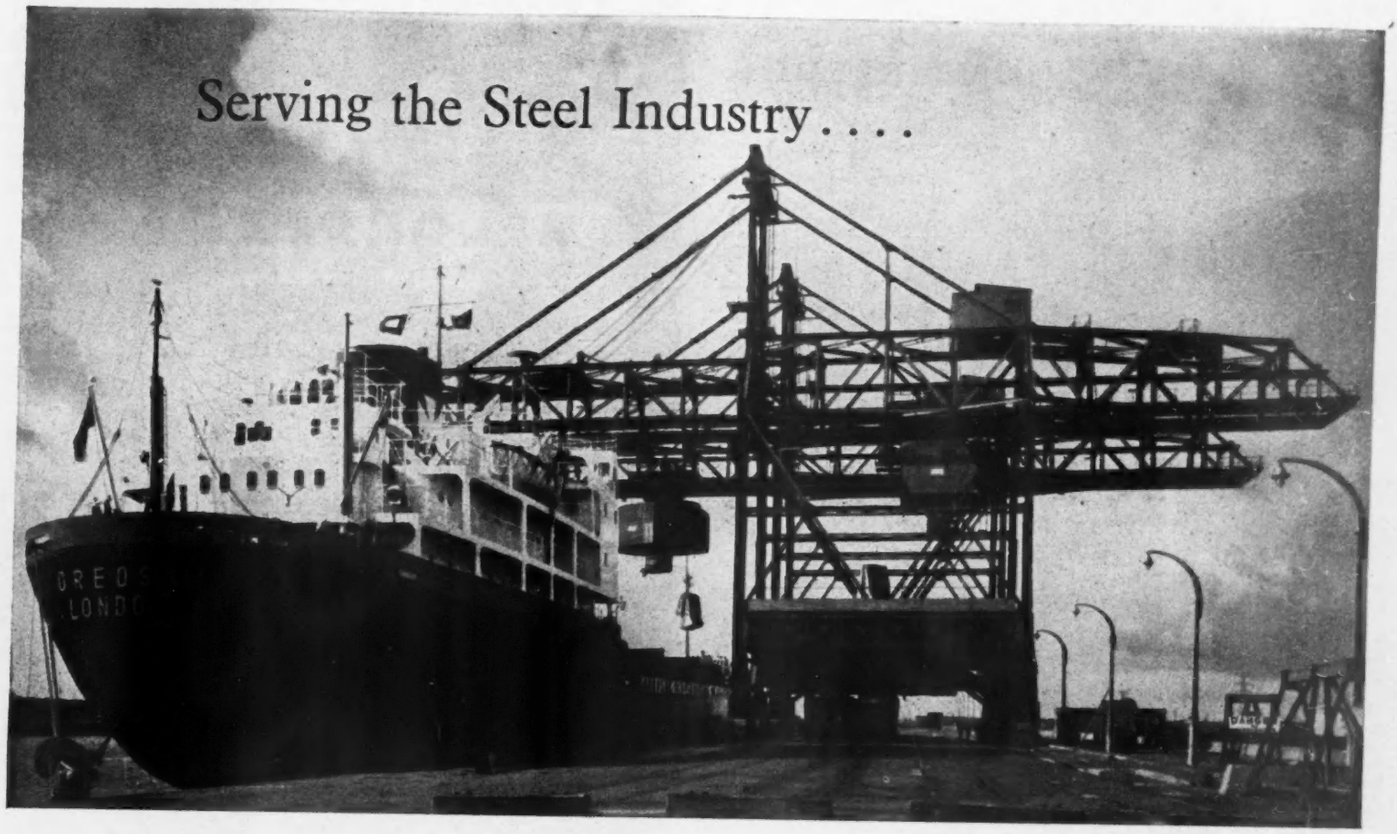

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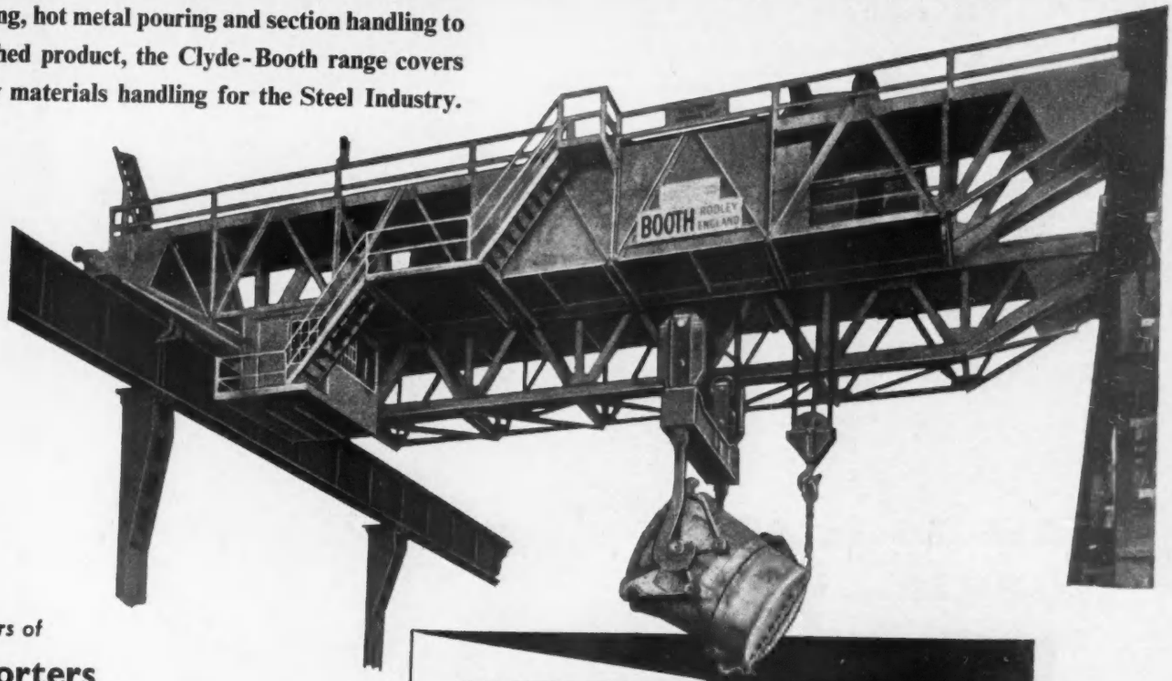

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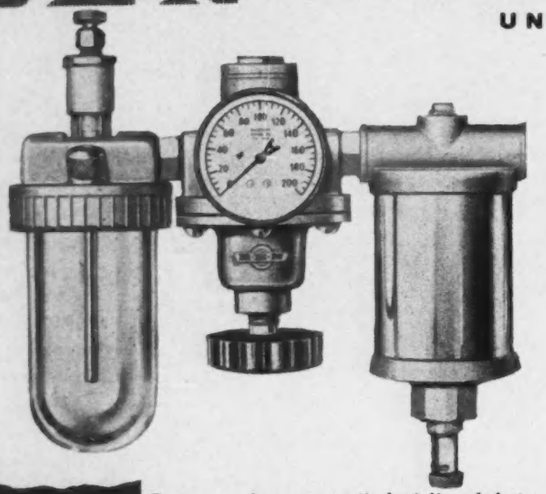

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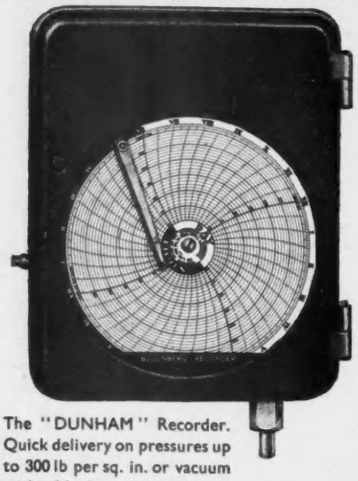

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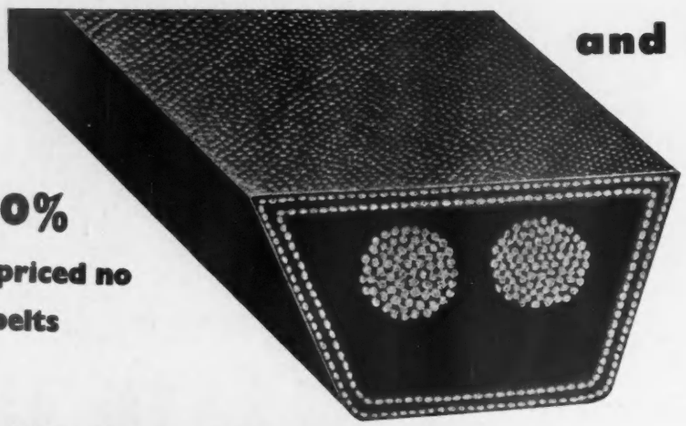

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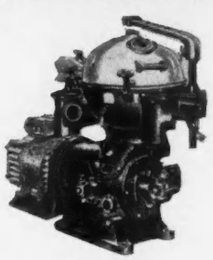

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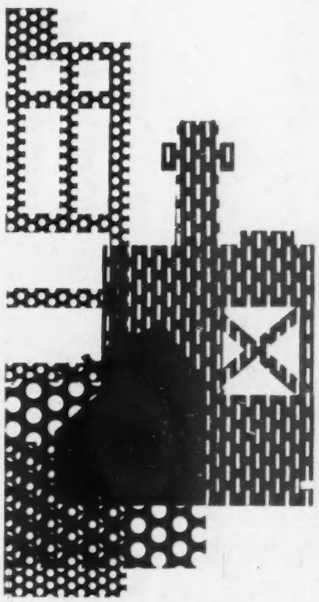

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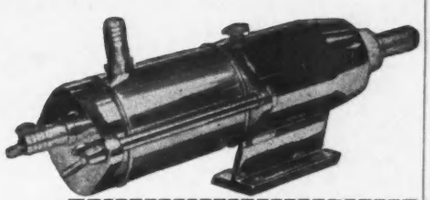

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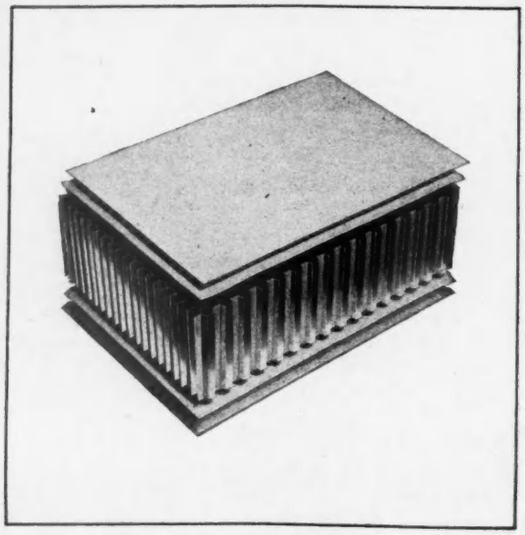

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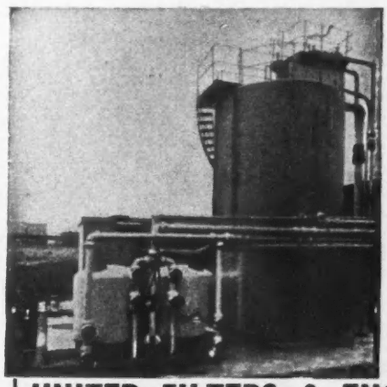

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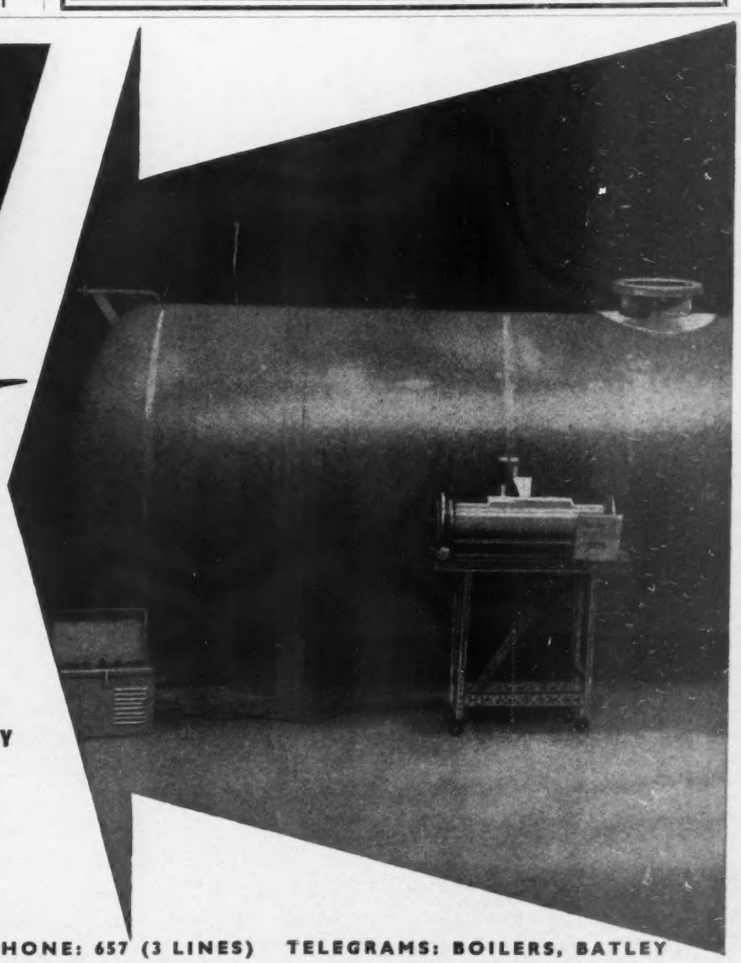

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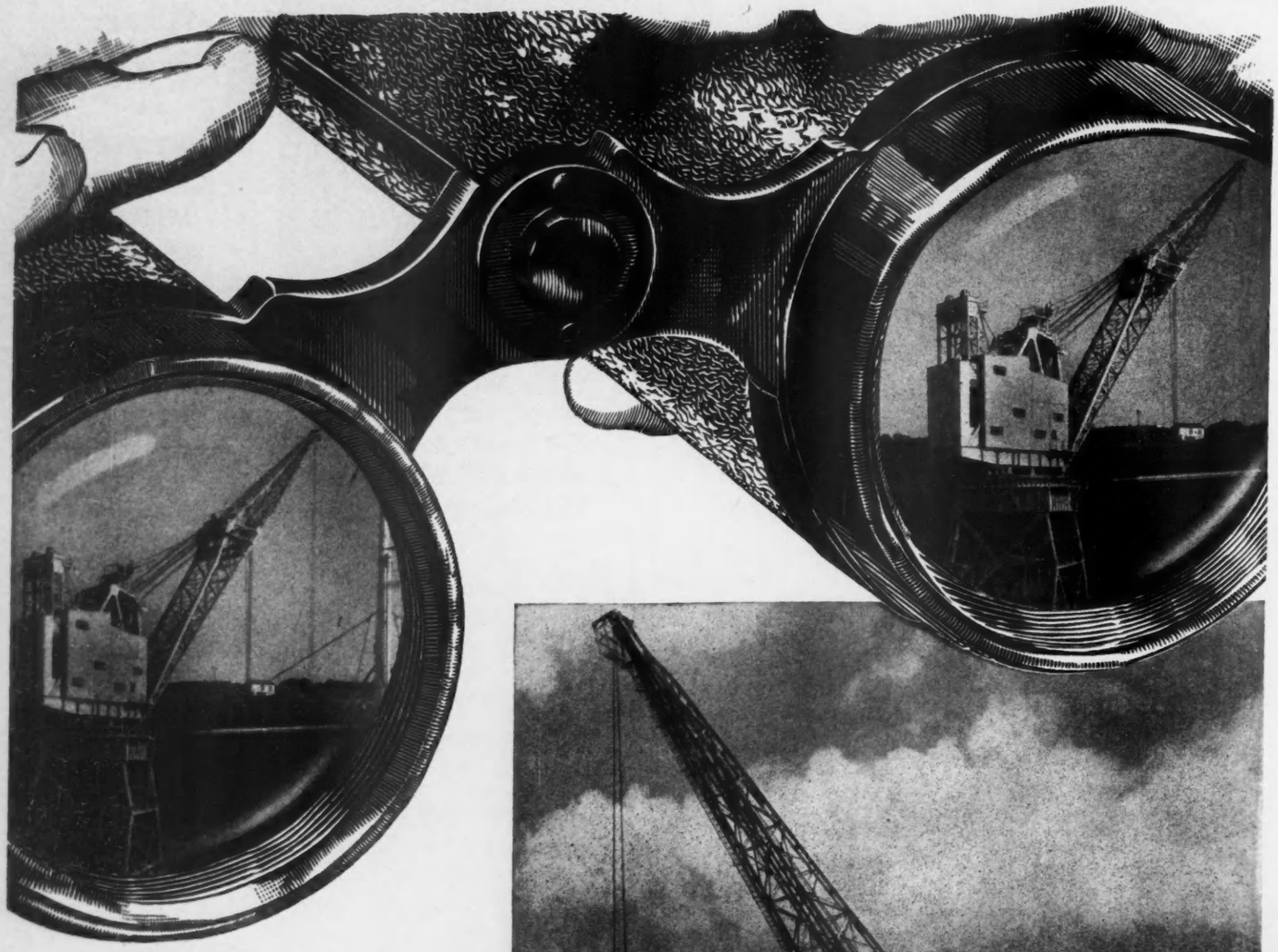

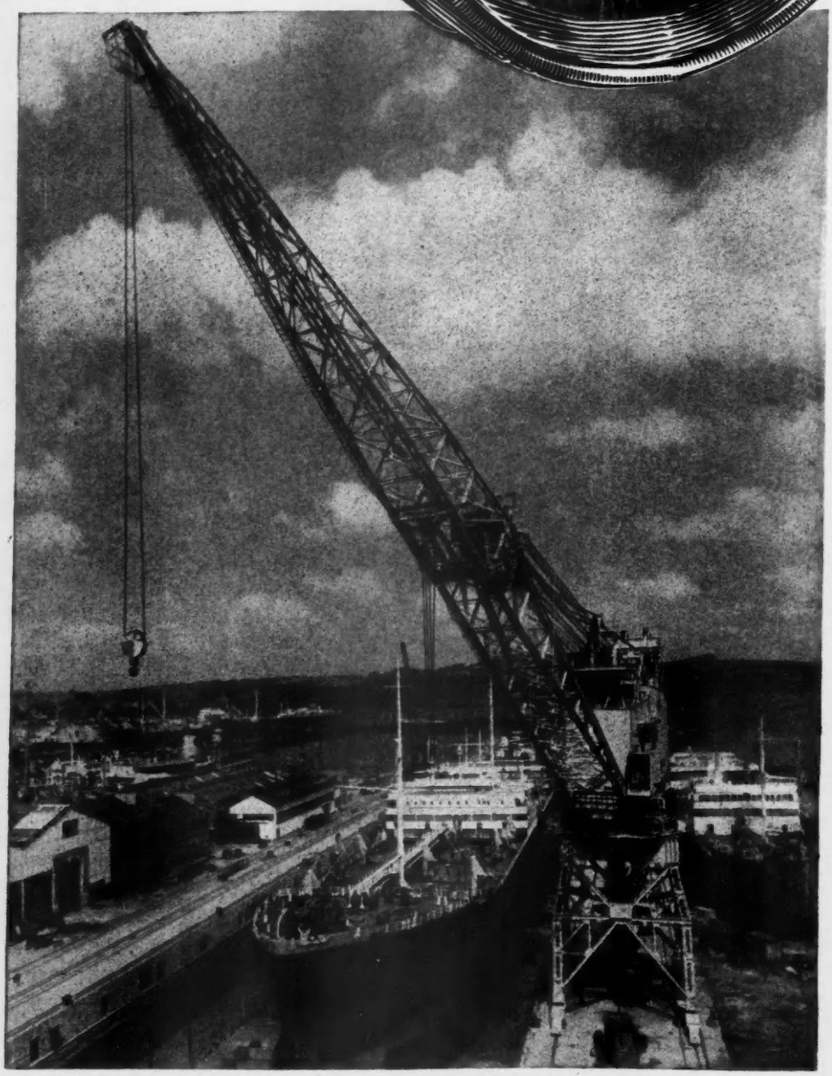

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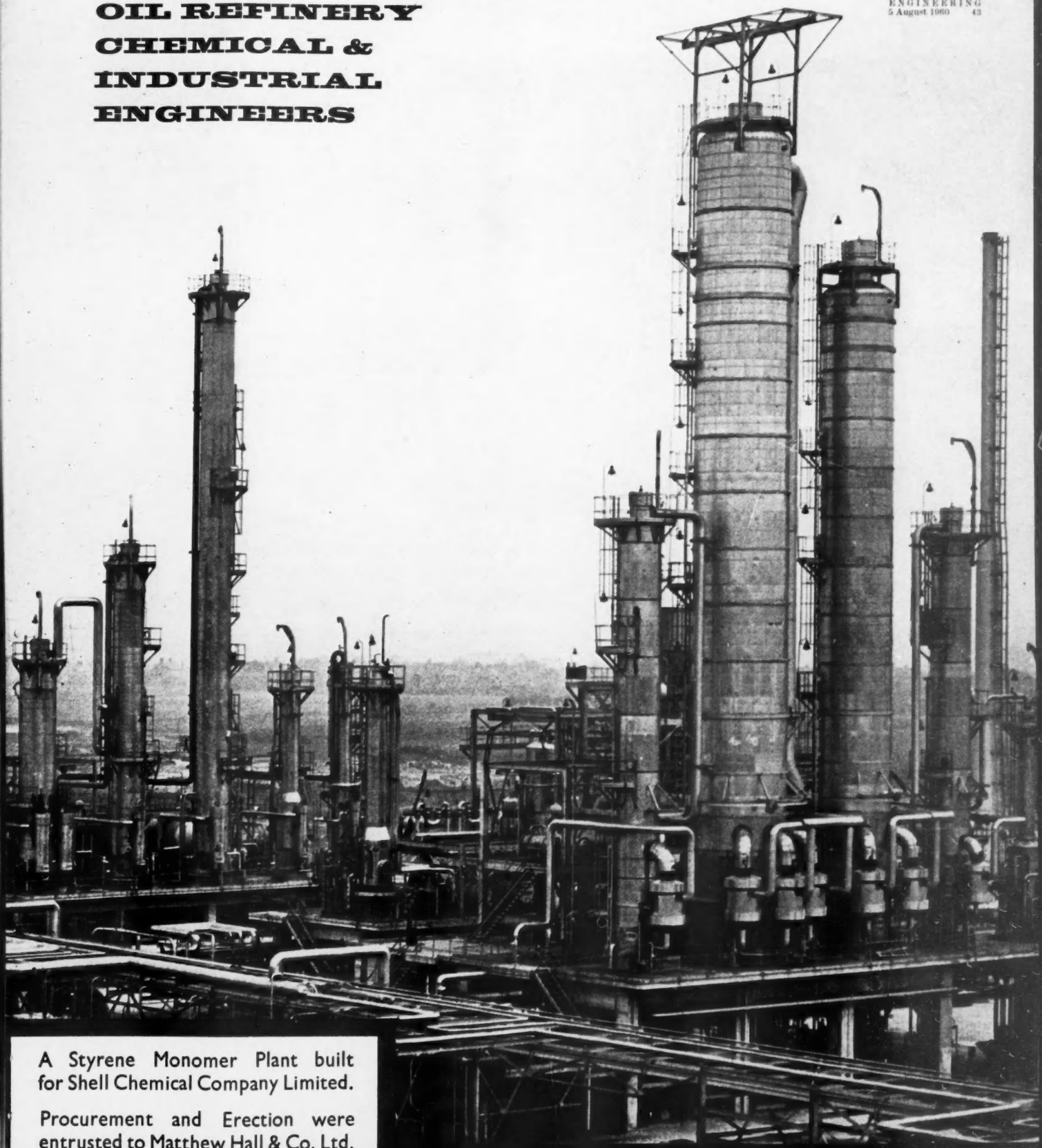

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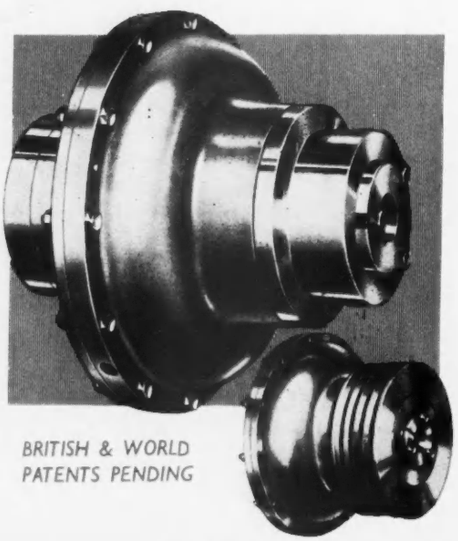

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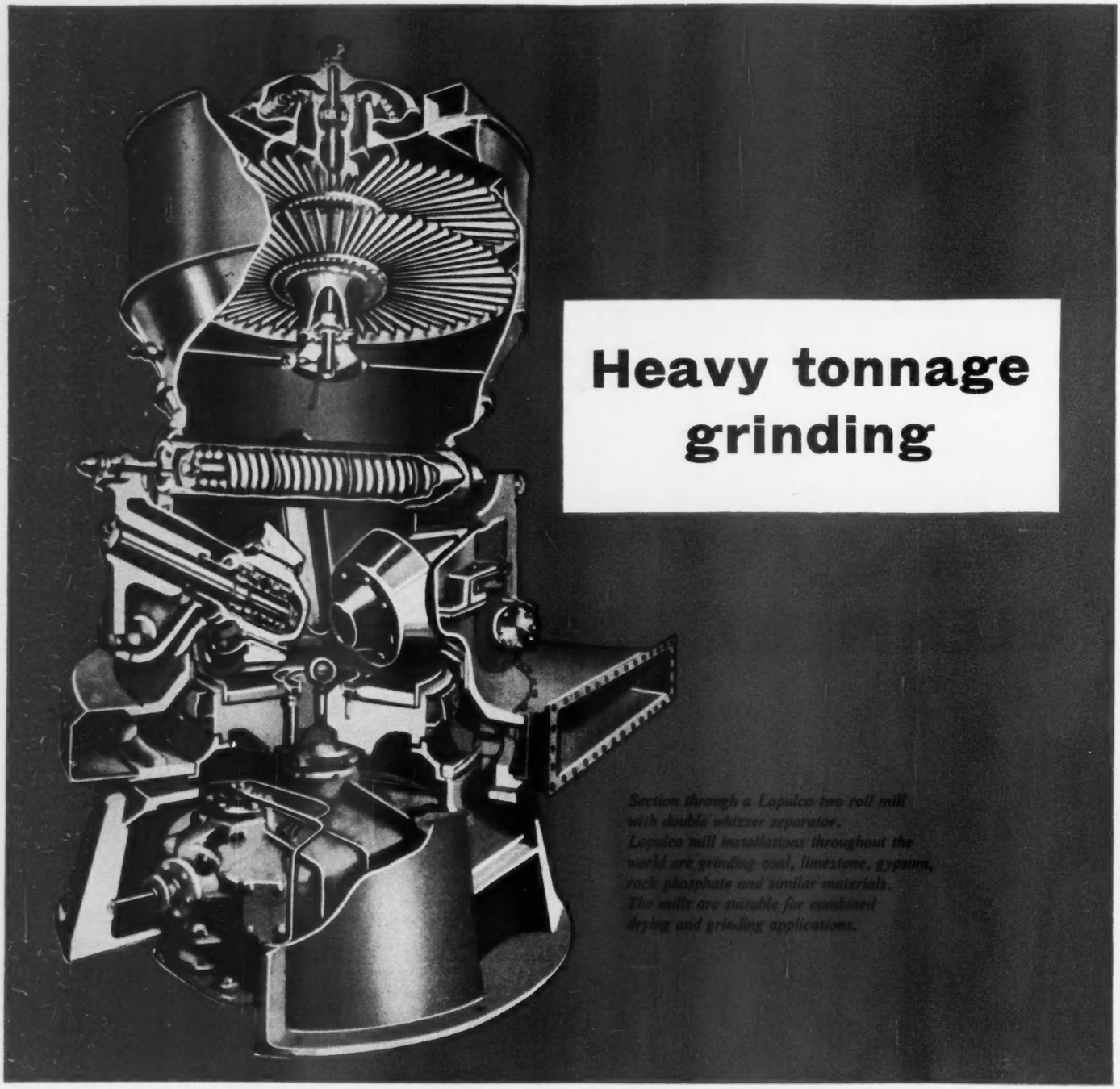

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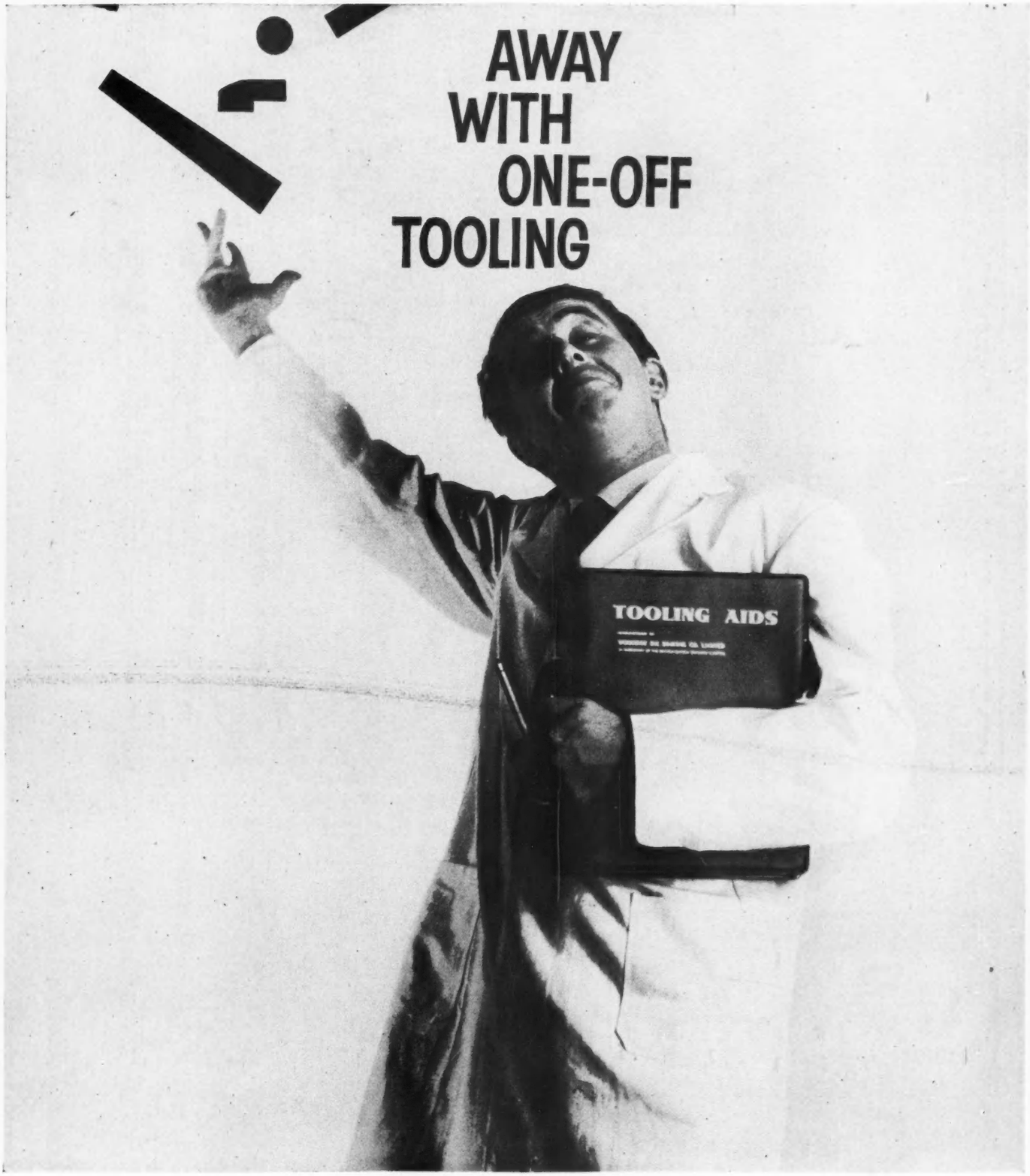

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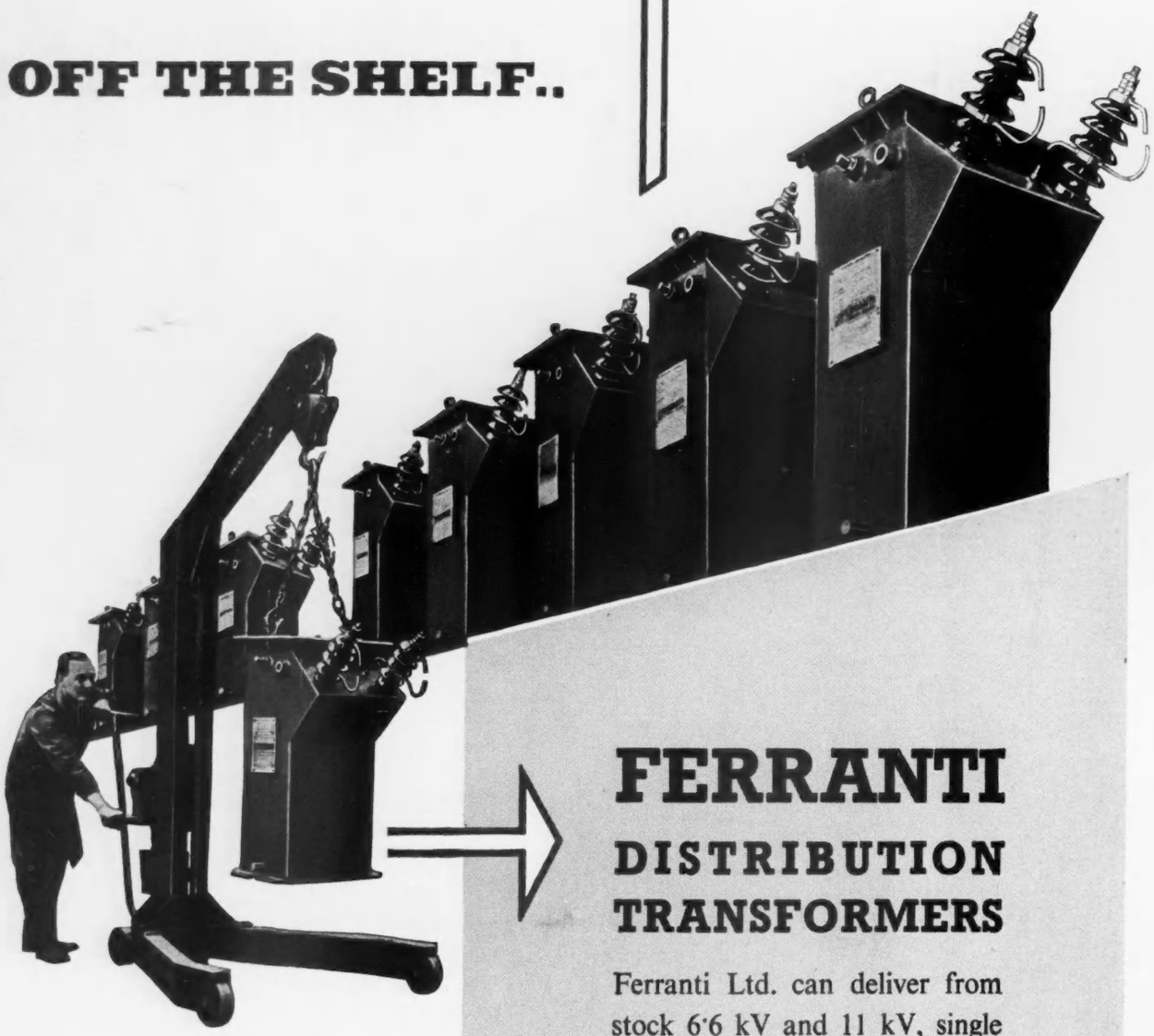

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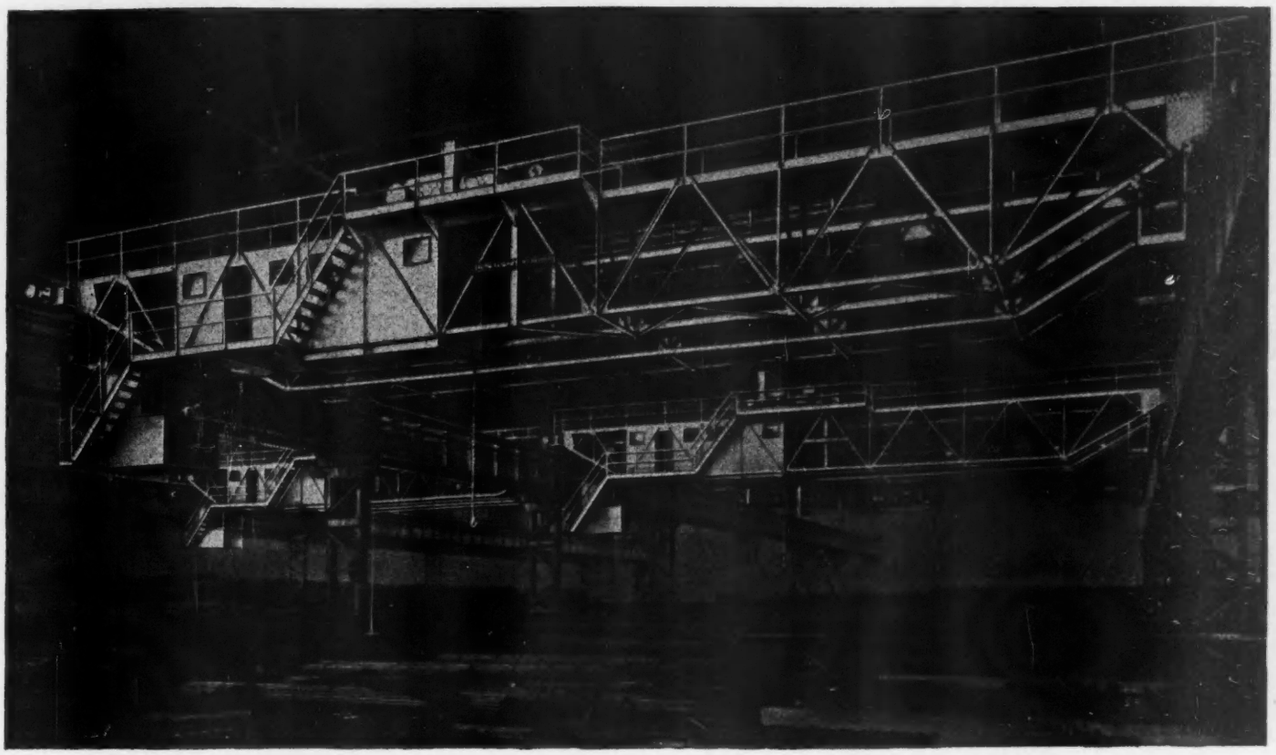

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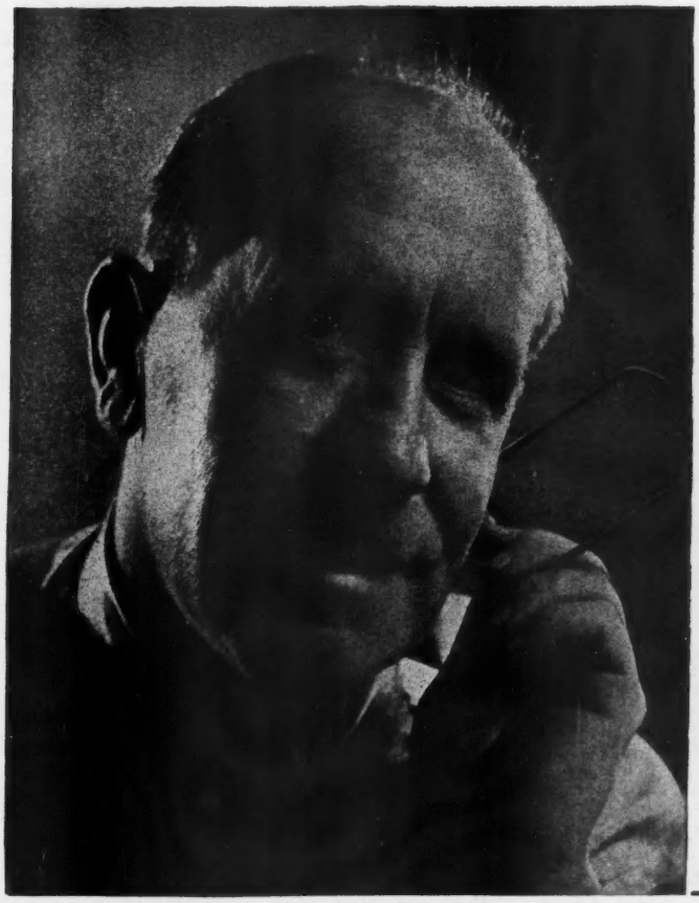

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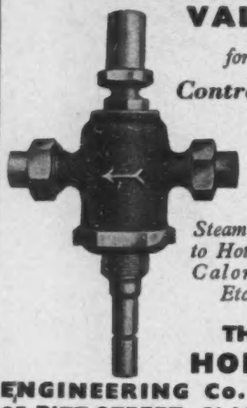

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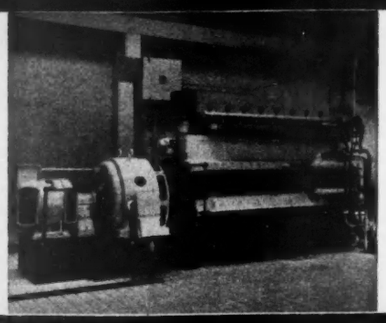

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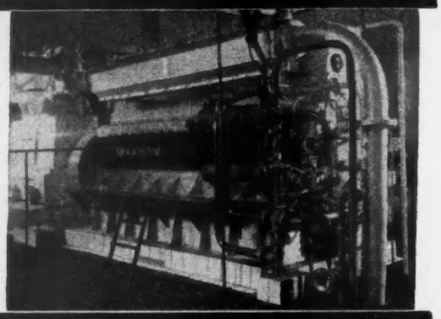

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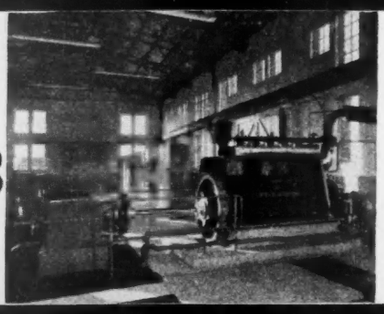

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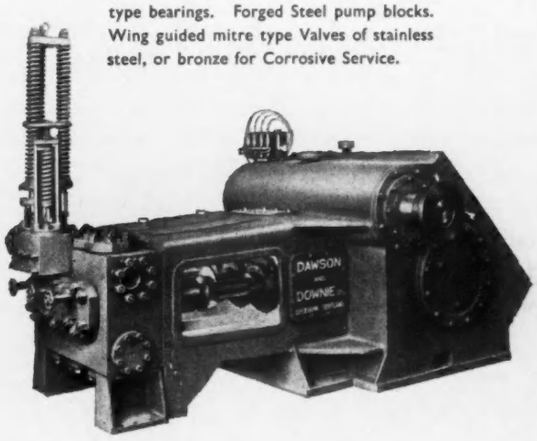

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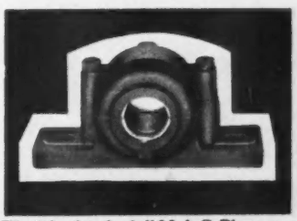

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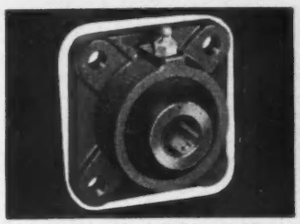

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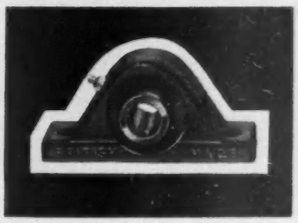

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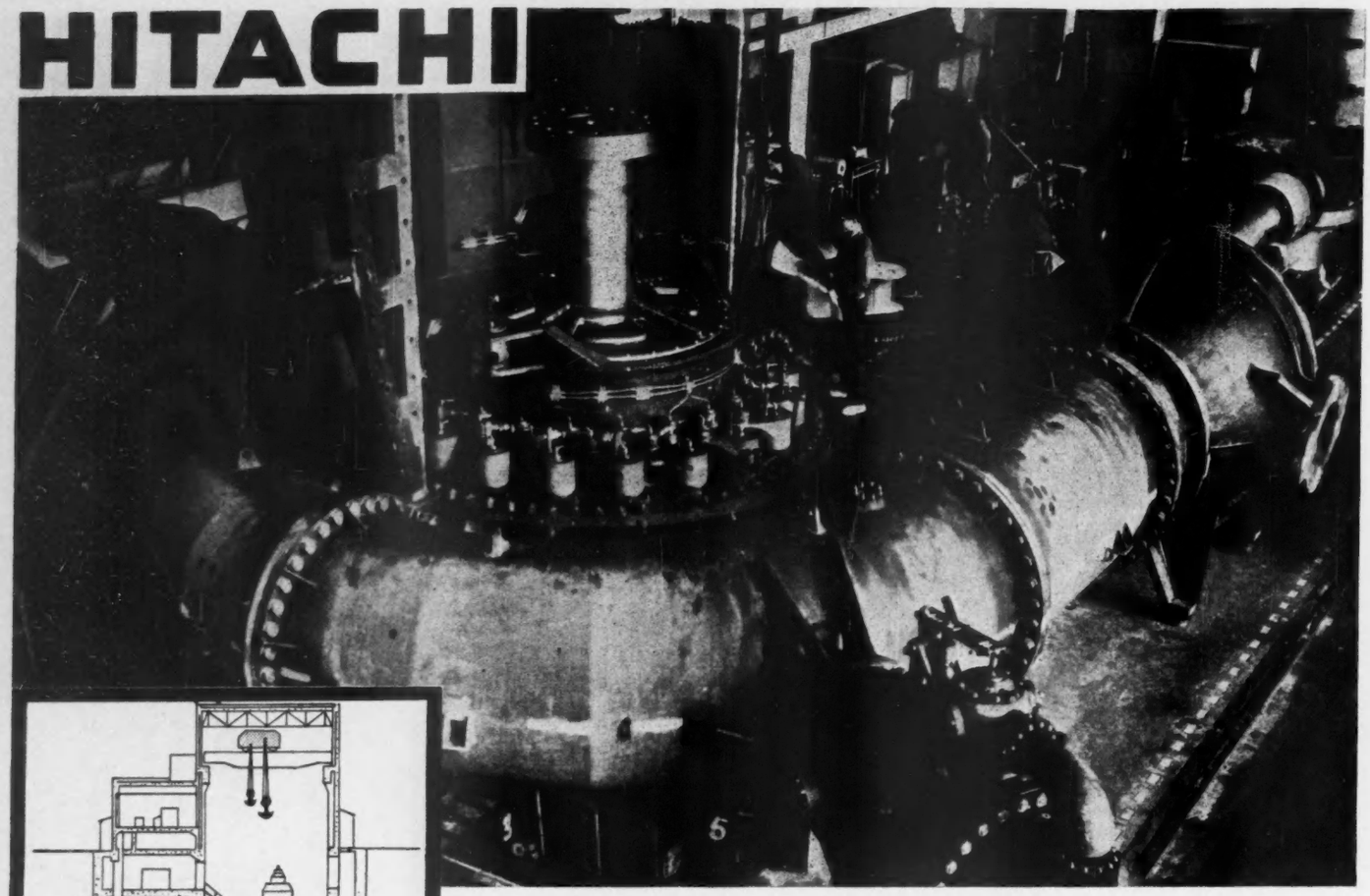
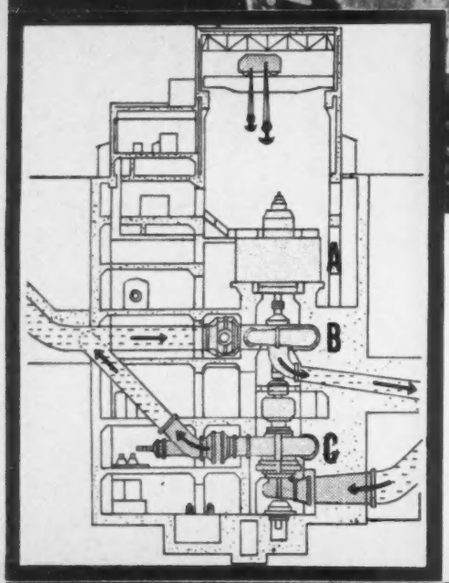
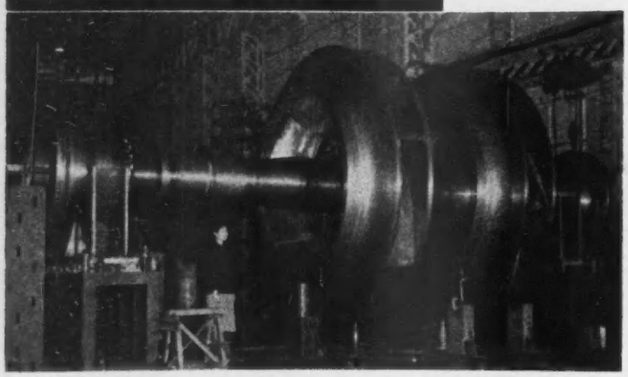




A Generator-Motor
B Turbine
C Pump

▼ Pump Impeller



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This pump is to be operated on surplus power when it becomes available on such occasions as rainy seasons or midnight operations for pumping up water to the reservoir. The water stored this way is used to increase power output of the station in the peak-load period.

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Pump	Quantity	18.6 m³/s
	Total Head	241.4 m
	Speed	300 rpm
Turbine	Effective Head	222 m
	Output	53,000 kW
	Speed	300 rpm

Generator-Motor	Output	58,000 kVA (Generator) 56,500 kW (Motor)
	Voltage	11,000 V
	Current	3,045 A
	Frequency	60 cycles
	Speed	300 rpm

Beside the above, Hitachi, Ltd. also made and delivered automatic operational control equipment, transformers, switchboards, A.C. circuit breakers, overhead travelling cranes and other equipment for the Morozuka Power Station.

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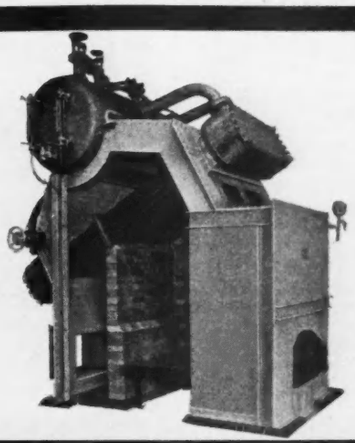

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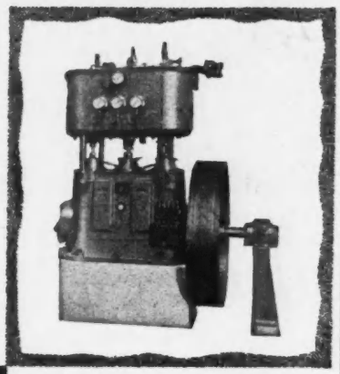

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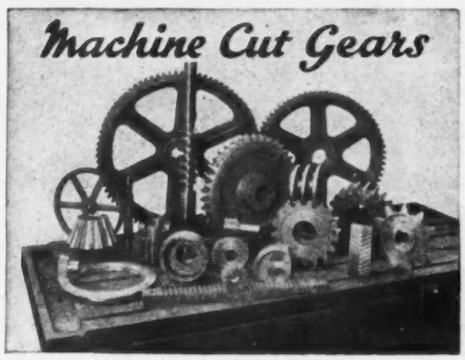

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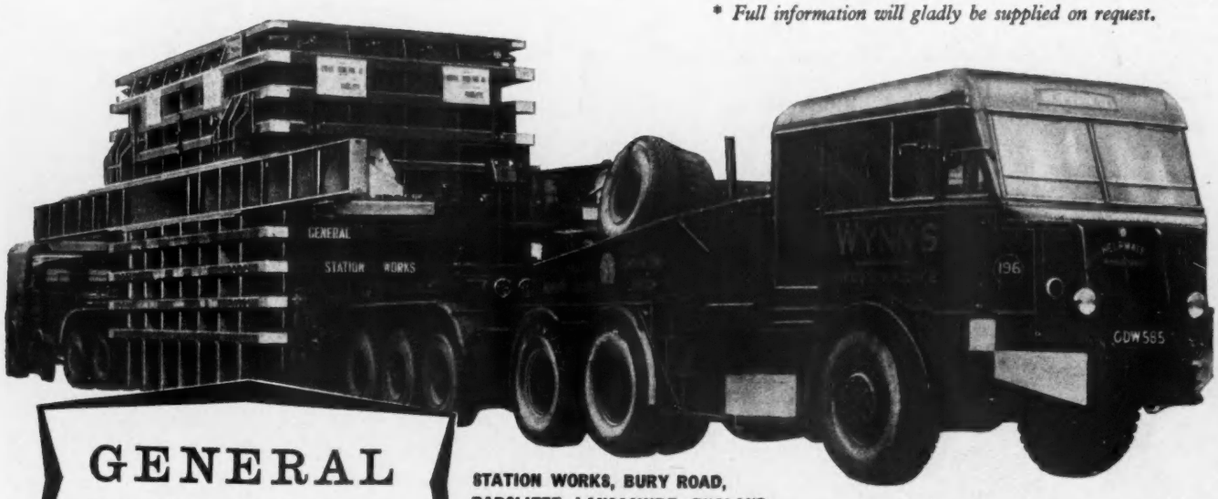

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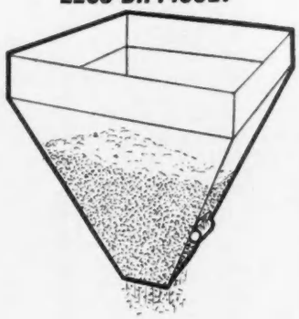
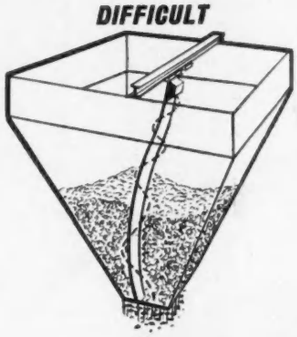


The installation of an external vibrator to a steel hopper.

trouble-free bunker discharge

DIFFICULT



The vibrating reed for application where external vibration is impractical due to structural or other difficulties and if the bunker is made of concrete.

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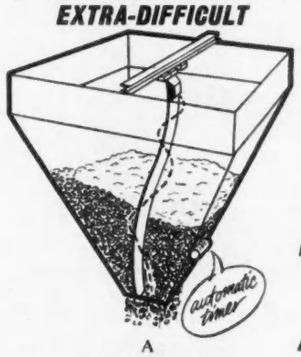

A combination of internal and external bunker vibration. Where the external vibrator is timed for 'on and off', the vibration frequency, on slowing down, goes through the natural resonance of the bunker, irrespective of load material contained.

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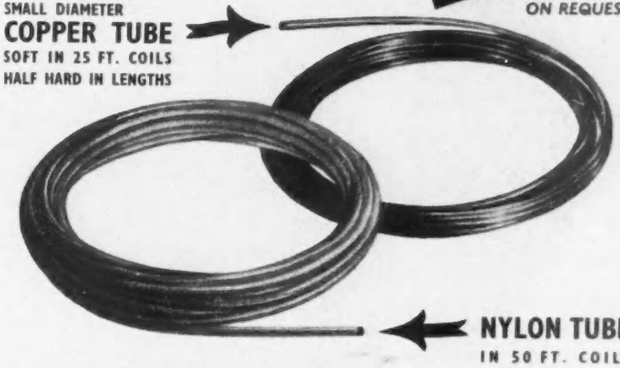

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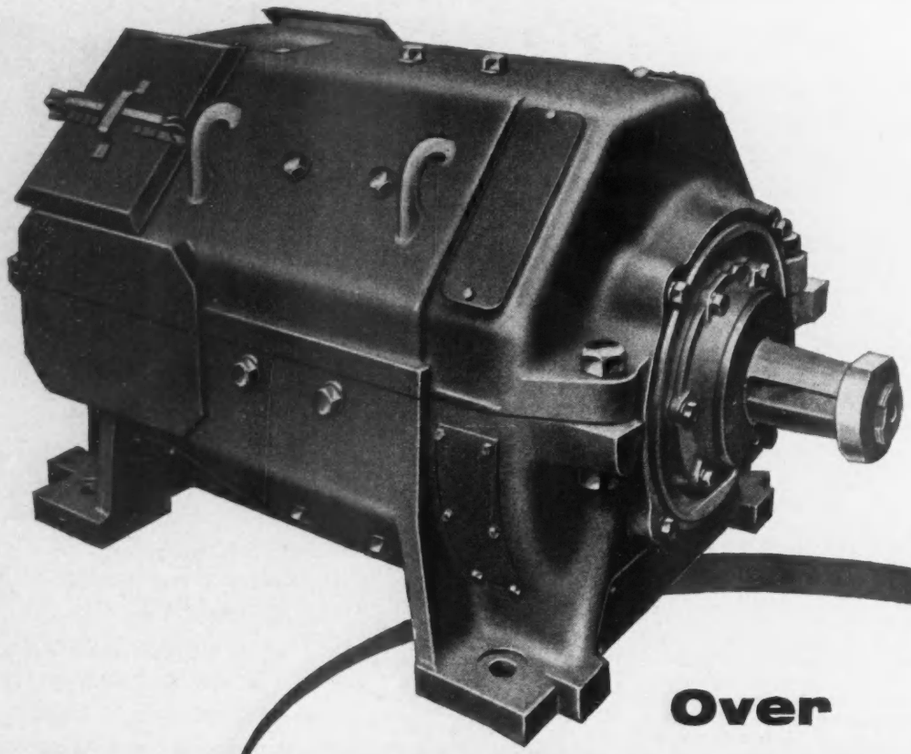

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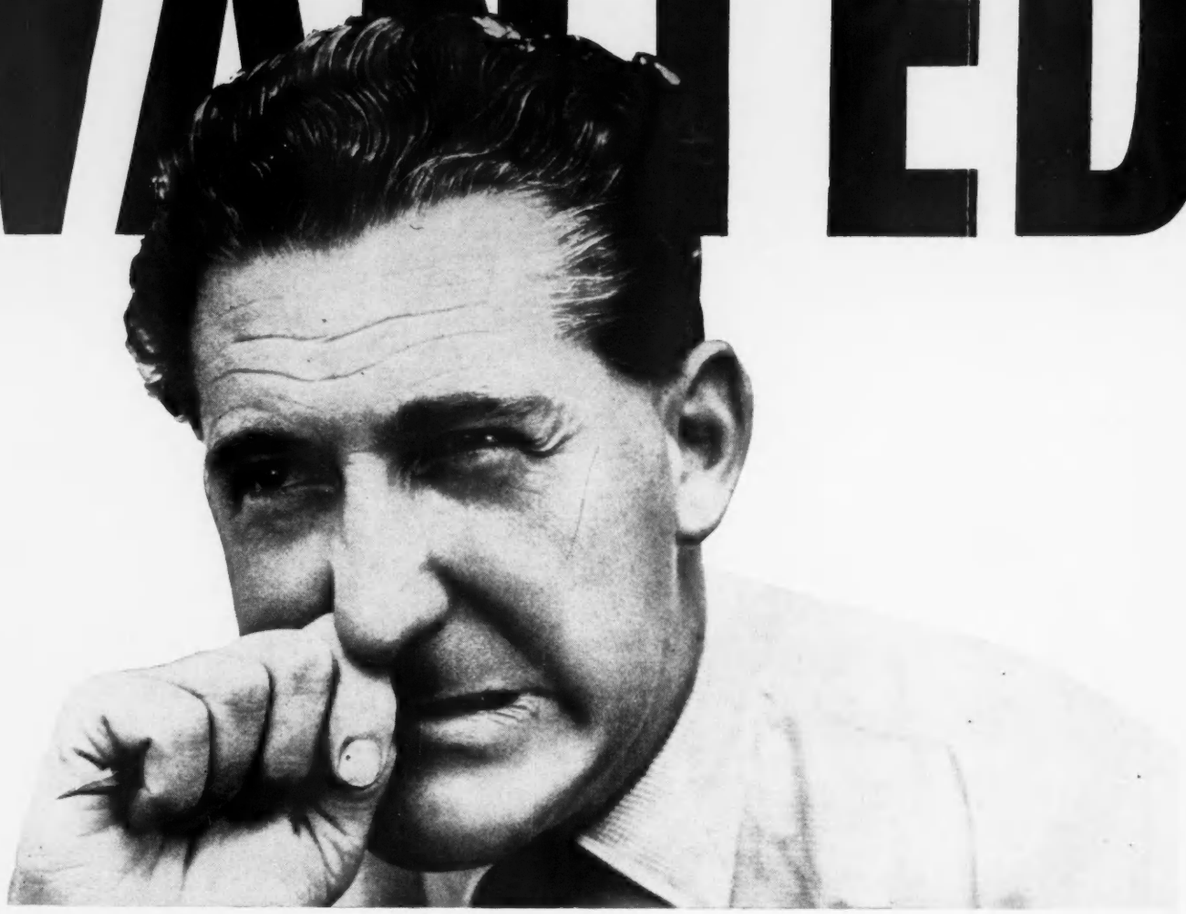

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